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DICKENS AND THACKERAY.

BY RICHARD A. PROCTOR.

(*Continued from p. 520.*)

BUT while Thackeray's success in delineating characters ordinarily met with in the world must be admitted by all who give the matter a thought, there are many who deny to Thackeray the power which Dickens is regarded as possessing in a very eminent degree—that, namely, of delineating such strange and whimsical characters as are less frequently met with.

Probably, if Thackeray had allowed himself the same license as Dickens in such matters, he would have been as successful in presenting in an amusing manner the grotesque, the fanciful, and the weird. The license I mean is that of combining in the same character incongruous characteristics. This license, indeed, Dickens took with characters of all orders; and not only so, but he took the further license of distributing among different characters the peculiarities of one and the same person whom he knew in real life. For instance, we know that some of the peculiarities of Micawber were copied from what Dickens had seen in his own father, while others were taken from other originals. So Mrs. Micawber has many ways which Dickens had noted in his own mother, while others of her peculiarities were not such as characterised Mrs. John Dickens. But we find also that while the oddities of Micawber and of his wife were borrowed from different sources, so the characteristics of Dickens' father and mother were distributed among different characters—Mr. and Mrs. Nickleby, Mr. and Mrs. Micawber, and so forth.

One of the most remarkable illustrations of Dickens's manner in such matters, a manner unquestionably resulting from deficiency of the creative faculty (which, until the real origin of many of his characters had come to be known, was mistakenly supposed by inexperienced readers to be possessed by Dickens in a very large degree), is to be found in Dora and Flora. Copperfield's first meeting with Dora is Dickens's meeting (when little more than a boy) with a lady by no means so young as Dora is there represented. The courtship is derived from his youthful love for the original of Flora. The married life with Dora, so far as her household ways are concerned, presents Dickens's own experience, so that Dora there represents a third person, and that person his wife. And lastly the death of Dora, and Copperfield's sorrow during the following years, are drawn from the death of his wife's younger sister, Mary, and the sorrow Dickens felt for years thereafter. Yet, though the real Flora furnished only one of these four copies from which the Dora of fiction was combined, we find her forming part of two distinct and very unlike characters, the characteristics of her later years being in part reproduced in Flora—but only in part, for some of Dora's ways were derived from other sources.

Nor can it be said that, after all, Dickens so artistically combines and distributes what he had observed that they become effective as if they were real creations. For no one possessing any power of critical discrimination had failed to recognise the incongruity of many—one may almost say all—of Dickens's characters long before it became known that he had constructed them of heterogeneous materials and applied his materials to heterogeneous purposes.

Another remarkable illustration of Dickens's manner of writing is to be found in a picture which is commonly, and in some respects justly, very much admired—the childhood and death of little Paul Dombey; yet the ways of the old-fashioned child were borrowed from one child, a child with whom Dickens had been exceptionally well acquainted (himself), while the latter scenes were, it is needless to say, taken from a different experience.*

And here I feel tempted to remark on a peculiarity of Dickens' manner of treating his subjects which would of itself show that he did not belong to that class of creative writers which includes all the really great names in literature.

Paul Richter used to say, "If an author has to stop and ask himself, 'What shall I make such and such a character do or say at such and such a point in the narrrative?' to the devil with him," implying that such a writer may possess superficial cleverness, but no genius. I wonder what Richter would have said of an author who not only thus hesitated, as we find that Dickens repeatedly did, but asked and took the advice of his friends about so critical a question as the fate of his principal characters, or even after writing the closing passages of a story adopted, at a friend's suggestion, an entirely different conclusion?

No one knew better than Dickens the requirements of true art. Nay, he often describes himself as living in his

* By the way, does any one know why the original description of the death scene was altered by Dickens in the later editions of "Dombey and Son"? I took up, on one occasion, a copy of "Dombey and Son" to read the account of Paul Dombey's death, after I had been speaking blasphemies about "the inimitable," for I knew that reading that scene would put me in a better frame of mind. I then found for the first time that a remark made by Miss Tox, after the child's death, has been excised. The account of Paul's death is followed by the words, "the old, old fashion Death! Oh thank God, all who see it, for that older fashion yet of Immortality! And look upon us, angels of young children, with regards not quite estranged, when the swift river bears us to the ocean!" And these remain in later editions; but in the original description there followed after a break, these words:—"'Dear me, dear me! To think,' said Miss Tox, bursting out afresh that night as if her heart were broken. 'that Dombey and Son should be a Daughter after all.'" In my essay on the "Shield of Achilles" ("Light Science for Leisure Hours," 1st Series) I touch on Dickens's frequent association of the humorous and the pathetic; and this particular instance had always seemed to me one of the most striking and effective. Dickens probably removed Miss Tox's quaint remark at the suggestion of Forster or some other injudicious friend. He failed, however, to remember another passage which should have been removed at the same time—viz., where Miss Tox, after Florence's return to her father, says:—"And so Dombey and Son, as I remarked upon a certain sad occasion, is indeed a daughter after all."

work and among the characters of his story, as the true artist should live; but it is certain that he deceived himself, for if he had he could never have been in doubt what their fate was to be, and still less could he have modified, at the suggestion of those who were comparatively strangers to his creations, the fate which he had decided should be theirs.

I am aware that other novelists have on occasion done likewise. Scott, for instance, consented to restore Athelstane of Coningsby to life after he had killed him, and a fine mess Scott made of that change; but, even if we assigned now to Scott the high position which was assigned him by contemporaries, it might still be answered that Athelstane was only a subordinate figure in the story, and that Scott would never have consented so to arrange matters to suit the popular taste—that the insipid Rowena should have disappeared and the gallant but shadowy Ivanhoe have married Rebecca, that most beautiful of all Scott's creations.

It need hardly be said that Thackeray does not allow himself such license as Dickens in the portraiture of character. Not a line can be found in the pictures of Costigan, Huxter, Rawdon Crawley, Lord Steyne, and the host of varied characters which appear in Thackeray's principal works, which can be regarded as incongruous, nor can I recall a single instance in which characteristics appropriate to one character are distributed among several. Again, Thackeray never, so far as can be judged, departs from that natural sequence of events which the development of his stories has suggested to him.

Thackery was content, in fact, to hold the mirror up to nature. I do not say that the portraiture is always perfect, still less that the work belongs always to the highest class. George Eliot seems to me to be as far in advance of Thackeray in many respects, as Browning is in advance of Tennyson. (For this reason she will always be less popular than Thackery, even as Thackeray is less popular than Dickens.) But the work Thackeray undertakes is always good work, and it is always well done. He does not seek to please by effective situations, by bringing in *per fas et nefas* humorous or pathetic images, though his humour is true, his pathos deep and touching. Nor does he care to make his stories "end well" or even end at all. They are slices from real life, and real life moves ever onward. His pictures, if not the finest, are among the best drawn of all that English writers have given us.

I have already said much more than I had intended when I began, yet I seem scarcely to have done more than touch upon my subject, so many considerations have I been obliged to omit which I had had in my thoughts. But there is one point which I must touch on, though briefly—viz., the quality of the language in which Thackeray and Dickens have expressed their conceptions. Here, as it seems to me, the two writers hold a nearly equal position. Thackeray, it is true, wrote more accurately, at any rate in his later works (for there is some very questionable English in his earlier writings). Dickens, indeed, repeatedly uses words in a wrong sense, and not unfrequently offends against the rules of grammar. He makes his worst mistakes when he aims either at fine or precise writing. Of the former we have a remarkable instance in a passage which Forster quotes with high approval, where Dickens speaks of a man being "an atheist in all the better feelings of our nature." Of the latter the most striking illustration which occurs to me at the moment is the passage where he says of Eugene and Bradley Headstone that "no matter who spoke or whom was addressed" they continued to watch each other.

But despite mistakes such as these there is a singular charm about Dickens's English. The charm resides partly in its clearness, partly in liveliness of imagery, but chiefly, I believe, in its perfect music. In order to appreciate Dickens's English fully let some of the descriptions in his "Uncommercial Traveller" be compared with writings on similar matters even by the ablest authors of the age. Of Dickens, indeed, we may say—though probably he himself would not have been disposed to admit as much—that "description was his forte."

Of the two writers Thackeray occupies far the higher position. His true place is daily becoming more clearly recognised. It will, I believe, be generally admitted before long that Charlotte Brontë was not far from the truth when she wrote (as nearly as I can recall the passage) that he was the foreman of that working body which sought to restore the warped order of things to rectitude. As she said, his wit is keen, his humour light, but they are no more by comparison with his serious power than the sheet lightning of the summer cloud compared with the scathing flash which leaps from its dark bosom.

THE PHILOSOPHY OF CLOTHING.

By W. MATTIEU WILLIAMS.

XI.—THE REMOVAL OF PERSPIRATION BY CLOTHING.

THE manner in which Rumford treated the question propounded at the conclusion of my last paper was simple and characteristic. He took equal quantities of the substances named in the following tabular statement "in a state of the most perfect cleanliness and purity," spread them out on clean china plates, and exposed them for twenty-four hours in the dry air of a room which had been heated for several months by a German stove, and kept up during the last six hours of the experiment to 85° Fahr. He then weighed them in the room.

After this they were removed to a table in the middle of a large uninhabited room on the second floor, and there exposed for forty-eight hours, the temperature of the room being 45° Fahr. They were then carefully weighed in the room; the increase of weight being shown in the second column below.

Thirdly, they were placed on a table in the middle of a very damp cellar, where the hygrometer indicated saturation of the air with moisture, and to maintain this saturation the vault was hung round with wet linen cloths, and the door shut. They remained here three days and three nights; the temperature of the vault was 45° Fahr. They were then weighed in the vault. The table displays the results:

Substances.	Weight after 48 hours in dry room at 85°.	Weight after 48 hours in ordinary room at 45°.	Weight after 72 hours in damp cellar at 45°.
Sheep's wool	1,000	1,084	1,163
Beaver fur	1,000	1,072	1,125
The fur of a Russian hare	1,000	1,065	1,115
Eider down	1,000	1,067	1,112
Silk — Raw, single thread	1,000	1,057	1,107
Silk — Ravelings of white taffety	1,000	1,054	1,103
Linen — Fine lint	1,000	1,046	1,102
Linen — Ravelings of fine linen	1,000	1,044	1,082
Cotton wool	1,000	1,043	1,089
Silver wire, very fine, gilt and flatted, being the ravelings of gold lace	1,000	1,000	1,000

In reference to the wire, Rumford adds that it was not included from any idea that such a metal could imbibe moisture from the atmosphere, but in order to learn whether it "is not capable of receiving a small addition of weight from the moisture attracted by it and attached to its surface."

He further tells us that he was totally mistaken in his conjectures relative to the other substances. He says:—"As linen is known to attract water with so much avidity; and as, on the contrary, wool, hair, feathers, and other like substances, are made wet with so much difficulty, I had little doubt but that linen would be found to attract moisture from the atmosphere with much greater force than any of those substances; and that under similar circumstances, it would be found to contain much more water. And I was much confirmed in this opinion upon recollecting the great difference in the apparent dampness of linen and woollen clothes, when they are both exposed to the same atmosphere. But these experiments have convinced me that all my speculations were founded upon erroneous principles."

As already stated, the subject of the adhesion of gases to solids was at that time but little understood; the important fact that such adhesion effects great condensation of the gases upon the surface of the solids was not understood at all. It is this dense and firmly adhering film that prevents the wetting by water in its liquid state. The vapour of water being a gas, the paradox which puzzled Rumford may be explained by this fact. His experiments measured the quantities of gaseous water adhering to the different fibres.

This gaseous film being invisible and demanding careful experimental research to demonstrate its existence, still remains but little understood, and the crude idea that a solid surface must be oiled in order to render it repellent to water still remains rather obstinately fixed in the minds of those who have not studied the subject. This is shown by the letter of "G. A." No. 1,776, page 533. A little further study of the subject will teach him that this "oil gland," as he calls it (the *uropygium*), is by no means peculiar to the duck or other aquatic birds. This has been so long known that Paley, in his "Natural Theology," dated 1802, describes it as a "specific provision for the winged creation" generally. The observations of Réaumur, who found that these tail glands vary with the development of the tail feathers, and are absent in those varieties of fowls which have no tails point to their true function. If "G. A." will take the trouble to watch the action of a duck or swan in preening its neck and breast, he will learn that the old story of the bird squeezing out some tail oil with its beak and then smearing it over its feathers is pure fiction. I shall return to the subject of bird clothing when I come to the uses of eider-down and the down of other species of ducks, in human clothing.

Rumford suggests that the apparent dampness of linen to the touch is analogous to the apparent heat of bodies when similarly touched. Good conductors appear much hotter or colder than bad conductors of same temperature, on account of the greater freedom with which the conductor parts with its heat when hotter than the hand, or takes away the heat of the hand when cooler; so, he supposed, may the linen more easily part with the small quantity of water it contains.

The fact is, that the linen is *really* more wetable (to coin a convenient word) than the flannel, as may be shown by exposing an equal surface of linen and of flannel to the same shower of rain and comparing the result. Much of the water rolls off the woollen fabric, very little from the linen before it has become saturated.

Having by the above-described experiments shown that the sheep's wool does absorb so much vapour of water, he applied the results as follows, to explain the promotion of insensible perspiration by wearing flannel next to the skin.

"The perspiration of the human body being absorbed by a covering of flannel, it is immediately distributed through the whole thickness of that substance, and by that means exposed by a very large surface, to be carried off by the atmosphere; and the loss of this watery vapour which the flannel sustains on the one side, by evaporation, being immediately restored from the other, in consequence of the strong attraction between the flannel and this vapour, the pores of the skin are disencumbered, and they are continually surrounded by a dry, warm, and salubrious atmosphere."

There is one error in this description of the action which modern research now enables us to correct. The loss sustained by the flannel on one side is not due to *evaporation*, but to gaseous diffusion.

No two gases of different composition can remain in contact with each other without mutually intermingling or diffusing themselves through each other. This diffusion is reducible to definite quantitative laws which have been determined by the elegant and extensive researches of Graham. But for this diffusion, and the fact that it overpowers gravitation, we could not live upon the earth. Every poisonous exhalation from decaying organic matter or other sources would remain fatally concentrated; the heavy carbonic acid given off from our lungs and skin would flow down all the slopes of the earth, covering the plains and filling the valleys with an invisible ocean of suffocating poison. As it is this gas, though bulk for bulk nearly double as heavy as the other constituents of the atmosphere, rises above the highest mountain tops, and spreads freely and nearly equally throughout. The enormous quantities generated in our crowded cities are always going out of town, even during a dead calm.

Aqueous vapour diffuses like other gases, and thus it is removed from our bodies in the manner described in the above quotation, if we merely substitute the word diffusion for evaporation. This substitution is not merely a verbal quibble, but expresses an important practical difference. A closely-woven linen garment that is *wetted* by the perspiration does precisely what Rumford describes; it absorbs liquid water on the side next the skin, and this is evaporated from the wet outside of the fabric, while the loosely-distributed fibres of a suitable woollen fabric take hold of the vapour of the insensible perspiration in its gaseous form, and by virtue of gaseous diffusion continually exchange this with the gases of the outer atmosphere. Diffusion must be taking place throughout all the gas-filled interstices between the fibres, and the gaseous film adherent upon the surface of each fibre must, by similar diffusion, continually exchange itself with the surrounding atmospheric gases.

The significance of the figures in the above tabular statement of Rumford's results will be better understood by reflecting on the following.

As the wool, &c., were weighed in the room where their temperature was the same as that of the surrounding atmosphere the adherent matter which added to their weight was aqueous vapour, not liquid water condensed by cooling. This theoretical conclusion is confirmed by the fact that the ravelings of gold lace gained nothing—condensed no water at all while exposed under the same conditions. The specific gravity of aqueous water is $\frac{1}{1100}$ of that of water. The specific gravity of wool fibre is a little greater than that of water, about 1,800 times that of aqueous vapour. Therefore the 163 parts of vapour gained by the sheeps'

XUM

wool in the experiment must have had originally a bulk of $\frac{1800 \times 163}{1000}$ times that of the whole quantity of original fibre, *i.e.*, more than 293 times the bulk of the fibre itself. Such a quantity thus grasped by the fibre almost forces us to suppose that the condensation by adhesive attraction must have effected some degree of liquefaction, but if it reached actual liquefaction in the nearest contact layer, such liquefaction due to adhesion would differ from condensation by cooling in the important fact that the latent heat of the gaseous water would still be retained, and with it the property of gaseous expansive energy.

OPTICAL RECREATIONS.

BY A FELLOW OF THE ROYAL ASTRONOMICAL SOCIETY.

(*Continued from page* 321.)

HAVING arrived at this stage in the treatment of our subject, we are placed in a certain amount of difficulty, since the next natural division of it is that dealing with the phenomena of chromatics. This, however, can scarcely be treated without reference to prismatic, or spectrum, analysis; and on this particular subject the Conductor of KNOWLEDGE has himself promised a series of papers (under the title of "Light-sifting"). Now until these appear, our reference to the nature of colour and the mode of its production can scarcely be other than disjointed and incoherent. As an introduction, however, to the whole subject, it may not be entirely out of place if we essay to give some idea of the method by which the immortal Newton first measured the thickness of the film of any material sufficiently attenuated to exhibit chromatic phenomena. This primarily depends upon that principle of "similar triangles," which underlies the determination of lunar, planetary, and even stellar distances.

The practical photographer knows how, when printing from his plates, he screws the back of the glass negative very tightly up against the glass of the printing-frame, curved bands of beautiful colours often become visible. The same thing may be seen, too, between two laminæ in a mass of mica, on ancient glass, &c. Now these colours are produced in the thin film of air between the plates, or oxidised film in the case of old glass vessels, and what Newton set himself to do was to measure the thickness pertaining to each particular one. His actual apparatus was of the very simplest, consisting merely of a plano-convex lens with a radius of convexity of 14 feet, and a double-convex one with a radius of 50 feet. Upon the plane surface of the first lens was placed one of the surfaces of the other or double-convex lens of 50 feet radius, and then, by the aid of three binding screws round their edges, the surfaces were brought into close apposition, as shown in Fig. 42, where we see that

Fig. 42.

between the convexity of the 50 feet radius lens and the plane surface of the 14 feet one a film of air is enclosed, gradually increasing in thickness outwards from the central point where the lenses are in contact, and where of course, it has *no* thickness at all. Now if we look down on to such an arrangement as this in daylight, we see a series of concentric coloured rings, as shown in the figure. The centre of the circles, where, as we have said, the two lenses are in actual contact, is a black spot, outside of which, in succession, appear rings of pale blue, white, yellow, orange, and deep red. Following these is another series of violet, indigo, blue, greenish-white yellow, orange, bright red and crimson red (the popular "colours of the rainbow"). This is succeeded by a third, fourth, fifth, sixth, and seventh series, the colours gradually becoming more diluted as we proceed outwards, until they vanish. Now these successive alternations grow narrower and narrower as they recede from the central spot, in such sort that the *area* of each bright ring, measured from the darkest part of one alternation to the darkest part of the next, is equal. We shall presently see the meaning of this, and what are the numerical relations subsisting between the thicknesses that produce the same colour, in the successive orders or series of colours of which we have been speaking. The practical calculation, or rather the principle on which it is made, will be understood from Fig. 43, in which, how-

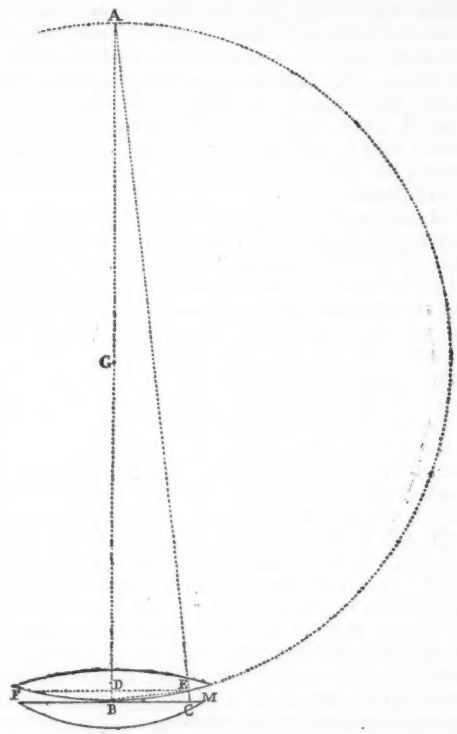


Fig. 43.

ever, the curvature of the double convex lens is grossly exaggerated, in order to show how the film of air, F M, gradually thickens as we proceed outwards. Let us suppose that we wish to find the thickness of the film of air which forms the ring B C, the radius of whose upper or concave surface, G B, is 50 ft.; in other words, the thickness, E C, in our figure. We will imagine that, on measuring to the point C from the central black spot, we find B C = 0·25 inch. Draw the chords A E and B E. Then (Euclid III., 31) A E B is a right-angled triangle, and if we further draw D E perpendicular to A B and = B C we get two other right-angled triangles A D E and B D E. These two last triangles are similar (Euclid VI., 8), and

hence the sides about their equal angles are proportional (Euclid VI., 4), so that A D : D E :: D E : D B (or E C), which is the thickness we want. Putting this into figures, 100 feet : ·25 inch :: ·25 inch : what we shall find to be ·000052083, or $\frac{1}{19200}$th of an inch, which is the thickness of the film of air at E C. If, instead of air, we fill the space between the two surfaces with any liquid, the rings diminish in radius, but preserve their proportions unaltered. In this way Newton was enabled to show that the thickness of a soap-bubble when, just before bursting, it exhibits the black of the first order of colours, must be less than ·00000075 inch!

So far we have supposed our "Newton's rings," as they are called, to be formed in ordinary daylight. If, however, instead of sunlight, which is compounded of all the colours, we employ monochromatic light, we shall find that the rings will consist alternately of black ones, and others coloured by our source of illumination. Thus if we light our tangent lenses with red light, we shall have red and black circles alternately exhibited round our central black spot; with yellow light, yellow and black; with violet light, violet and black; and so on. But this is not all, with red light the rings are largest; with orange, smaller; with yellow, smaller still; and so on through green, blue, indigo, violet, &c., gradually contracting as the light employed becomes more refrangible. Another notable fact was brought to light by Newton's measurements. He found the squares of the diameters of the brightest parts of each ring to be in the arithmetical progression of the odd numbers 1, 3, 5, 7, 9, &c., and the squares of the diameters of the darkest parts in the arithmetical progression of the even numbers 2, 4, 6, 8, and 10; and when we reflect that one of the glasses is plane, and that the differences of thickness are directly referable to the equable curvature of the other, it will be seen at once that the distances between them at these rings must be in the same progression when the incident white light is perpendicular. Newton found that the thickness of the air-film at the darkest part of the first dark ring was $\frac{1}{89000}$th of an inch. By multiplying this number by the progression 1, 3, 5, 7, 9, &c., and by 2, 4, 6, 8, 10, he obtained the results set forth in the following little table:—

	Thickness of the air at the most luminous part.	Thickness of the air at the most obscure part.
First Ring	$\frac{1}{178000}$	$\frac{2}{178000}$ (or $\frac{1}{89000}$)
Second Ring	$\frac{3}{178000}$	$\frac{4}{178000}$
Third Ring	$\frac{5}{178000}$	$\frac{6}{178000}$
Fourth Ring	$\frac{7}{178000}$	$\frac{8}{178000}$

Observe the significance of this. Here is proof positive that *something* is recurring periodically, and rhythmically. Newton explained the observed phenomena on his emissive hypothesis (to which we have previously referred in these papers) by supposing that his material particles of light had poles and rotated round axes at right angles to the line joining these poles. If, then, we assume a particle to arrive at one surface of a film of a particular thickness, it would have just time to turn once completely round, thus presenting its attractive pole to the surface of the glass underneath, into which it would be pulled and be lost to the eye In a film twice as thick it would make two complete rotations with the same result, and so on. Hence the dark rings. In the case of a film of *half* the thickness, however, the supposititious corpuscle would only have time to turn half way round, would present its repulsive pole to the second surface of the film, and would be reflected; the same thing happening when the film was one and a-half times as thick, and so on: whence arose the bright rings. Newton's not very happy phraseology in accounting for the phenomena on his emissive hypothesis, describes the corpuscles of light as being affected by "fits of easy transmission and reflection." We have before intimated how, were this hypothesis true, the velocity of light should be greater in water, glass, &c., than in air or vacuo; and that the fact of light being *retarded* in refracting media having been experimentally established, Newton's conception was at once shown to be baseless. Moreover, reverting to this particular experiment on which we have been treating, Newton's assumption was that the action of reflection or transmission which formed the rings took place at a single surface (the second one), whereas by destroying reflection from one of the two internal surfaces bounding the film, we cause every trace of the rings to vanish at once.

CHATS ON GEOMETRICAL MEASUREMENT.

By RICHARD A. PROCTOR.

THE CONE.

(*Continued from page* 480.)

A. We are now to deal with the volume of a cone.

M. Yes. The problem is a very simple one. As in the case of a cylinder we can take a cone on any base circular, elliptical, or irregular (so only, at least, that we can determine the area of the base); and the vertex of the cone may have any position, so long as we know the height of the cone.

A. I suppose we use, in this case, what we determined respecting the volume of pyramids; just as we used the known volume of prisms when dealing with the cylinder.

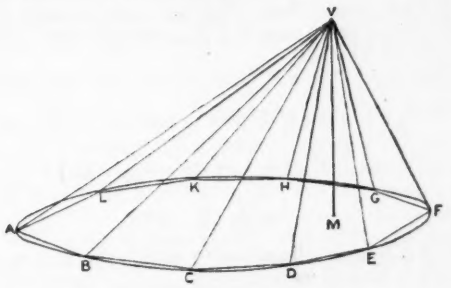


Fig. 4.

M. Precisely. Suppose for instance V, Fig. 4, to be the vertex of a cone on the base A B C D H, V M the height of the cone. Within the curvilinear area A B D H inscribe the polygon A B C D E F . . . . having a great number of sides, and join V A, V B, V C, &c. Then we have a pyramid A B C D . . . . V enclosed within the cone A B D H V. And manifestly we can make the volume of the enclosed pyramid as nearly equal as we please to the volume of the enclosing cone, by taking the points A, B, C, D, &c., sufficiently near to each other. For, the thin slices A B V, B C V, C D V, &c., left outside the pyramid will together be less than a conical shell enclosed between the conical surface A B C D . . . . V, and another having V as its vertex, A F as the plane of its base, and touching the planes A B V, B C V, &c.; moreover, this shell may be made as thin as we please, by making the sides A B, B C, C D, &c., of our polygon, as short as we please.

A. Wherefore, I see, the cone A B D H V is ultimately equal to the pyramid A B C D . . . . V.

M. Yes; and this pyramid, since the rectilinear area A B C D . . . . is ultimately equal to the curvilinear area,

A D F H, is equal, by what was shown in dealing with pyramids, to one-third the volume of a rectangular parallelopiped having its base equal in area to A D F H and its height equal to V M the height of the cone.

A. Therefore in the case of a cone on a circular base, having h for its height, and r as the radius of its circular base, the volume of the cone is represented by $\frac{1}{3}\pi r^2 h$?

M. Yes; and the volume of a cone of height h, on an elliptical base with semi-axes a, b, is represented by $\frac{1}{3}\pi abh$.

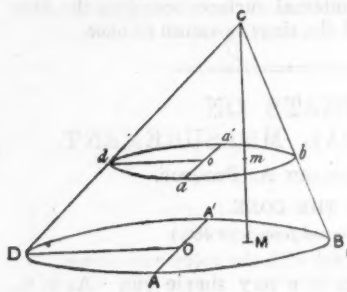


Fig. 5.

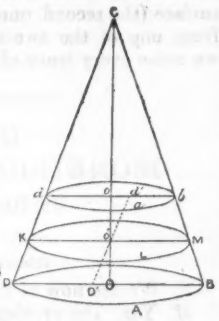


Fig. 6.

A. Will it not be convenient to have expressions also for the volume of frusta of cones?

M. Certainly. Suppose D a B (Fig. 5) to be a frustum of a cone, the complete cone being C D A B; the plane $d\,a\,b$ parallel to the plane D A B, C m M perpendicular to both these planes. Then frustum D a B is the difference in volume between the larger cone C D A B and the smaller cone C $d\,a\,b$; hence, from what has been already shown, vol. D a B = pyr. on area D A B, of height C M − pyr. on area $d\,a\,b$, of ht. C m.

If C M $= h$, C $m = h'$, and D A B, $d\,a\,b$ are circles of radii D O, $d\,o$, then if D O $= r$, and $d\,o = r\frac{h'}{h}$, and

$$\text{vol. D } a \text{ B} = \tfrac{1}{3}\pi\left(r^2h - \frac{r^2h'^2}{h^2}\cdot h'\right)$$

$$= \frac{\pi r^2}{3h^2}(h^3 - h'^3)$$

and if D A B is an ellipse having semi axes O A $= a$ and O D $= b$, it is obvious that

$$\text{vol. D } a \text{ B} = \frac{\pi a b}{3h^2}(h^3 - h'^3)$$

for $o\,a = \frac{a\,h'}{h}$; and $o\,d = \frac{b\,h'}{h}$.

If we suppose the cone a right circular cone, as in Fig. 6, and that the half-vertical angle D C O is equal to α, then, if C O $= h$, C $o = h'$, D O $= h \tan \alpha$, and $d\,o = h' \tan \alpha$. Hence

$$\text{vol. of cone} = \frac{\pi}{3}h^3 \tan^2 \alpha$$

$$\text{vol. D } a \text{ B} = \frac{\pi \tan^2 \alpha}{3}(h^3 - h'^3)$$

If we put o O $= k$, then

$$\text{vol. D } a \text{ B} = \frac{\pi \tan^2 \alpha}{3}\left\{h^3 - (h-k)^3\right\}$$

$$= \frac{\pi \tan^2 \alpha}{3}\left\{3h\,(h-k) + k^2\right\}k.$$

A. Of what use is this formula?

M. It is the simplest expression for the volume of a frustum in terms of the height, vertical angle, and the height of the frustum.

A. What relation does the volume of the frustum D a B bear to the volume of a cylinder having circle K L M (midway between D A B and $d\,a\,b$ for base), and o O for height?

M. You will find it an easy and pleasant exercise to show that drawing $d'\,o'$ D' parallel to C D,

vol. D a B = vol. cyl. on base K L M, and of ht. o O

+ vol. double cone formed by the revolution of triangles D' O o' and $d'\,o\,o'$ around o O.

(To be continued.)

IRISH SEASIDE RESORTS

FROM AN UNCONVENTIONAL POINT OF VIEW.

By Percy Russell.

(Continued from p. 521.)

SLIGO, the country of the O'Connors, whose feuds led to the conquest of Ireland, has a very striking and eminently picturesque coast, which is, however, very dangerous indeed for navigation, and excellent and productive fisheries.

Next, Mayo, with a coast-line of 250 miles, lofty mountains frowning against the Atlantic, with tremendous cliffs, and splendid salmon-fishing in the Moy. Achill Island I have spoken of already, and I may add that, to the tourist seeking really new scenes and fresh and very vivid impressions of really romantic coast scenery, Mayo offers many inducements—at a favourable season, however, for dreadful rains prevail at times from the Atlantic side.

These observations apply with even greater force to Galway, watered on one boundary by that magnificent river, the Shannon. Southwards are the Slieve-baughta mountains, and westward that remarkable group known, curiously enough, as the Twelve Pins, about 2,000 feet high. Nothing can well be more romantic than the west portion of these little-frequented and sparsely-peopled regions. The scenery is very wild and romantic; picturesque glens divide the lofty and rugged hills. The coast-line extends for four hundred miles, with remarkable sinuosities, and is fringed with a number of islands. The Connemara mountains edge a singularly wild coast, and well merits its specific name, Connemara—*Cun-na-mar—i.e.*, boys of the sea. The climate is mild, although rather humid, and the coast is well supplied with excellent fish. Here may be found numerous *raths* and *cromlechs*, monastic ruins, and at least seven of those mysterious round-towers, which still puzzle antiquaries. Clare County extends its coast from the Bay of Galway to the mouth of the Shannon, and, reckoning that fine estuary, has a line of 240 miles. Generally the sea-line itself is high, fantastic, and rocky, there being a great number of small isles and picturesque rocks. At one place the shore runs for full five miles nearly 400 feet above the sea, and everywhere presenting to it a perpendicular face of tremendous cliffs. Clare, like Galway, abounds in *cromlechs*, ruined monasteries, ancient castles, and round-towers. The climate is very much the same.

Quite as wild, rugged, and picturesque is the coast-line—about 200 miles—of Kerry, which is fringed with a number of islands, and has two very remarkable peninsulas occupied by lofty mountain ranges. Here rise up the famous Macgillicuddy's Reeks, already noted as including the highest mountains in all Ireland, and inland lie the famous lakes of Killarney. The fisheries on the coast are very good, and Dingle Bay, in particular, is remarkable for its splendid and, in some parts, sublime scenery.

Cork is the most southern and the largest of all the Irish maritime counties. The shores are very bold and uniformly

rocky, and extend for about 250 miles. Westward Cork is separated from Kerry by a great range of Silurian clay-slate, attaining a height of over 2,000 ft., and greatly adding to the romantic character of the western portion of the county. Numerous islands fringe the coast, among which is that known as Cape Clear, which is not, however, the most southerly point of Ireland in reality, as about four miles south there is a rock which geographers have neglected to individualise with a name. Like all the western counties of Ireland, Cork is very rich in antiquities. There are here many of those mysterious stone circles on the Druidic plan, round towers, *raths* (*i.e.*, circular works), and other remains of great archæological and historic interest. Waterford has a rocky coast, very dangerous for shipping. The surface is mostly mountainous, and there are some very remarkable caverns. Marble here abounds, and Celtic and Danish antiquities are numerous. The coast of Wexford presents, for the most part, a succession of bays and headlands, outlying rocks, and small islands, and geologically it belongs to the eastern clay-slate tract. More than a hundred ruined castles may be examined in this county, which is rich in interesting relics of the Anglo-Norman period.

Wicklow, the remaining maritime county completing our rapid tour of the Irish coast, has a shore-line stretching for about forty miles, and in some parts presenting that precipitous face to the sea which is the great characteristic of the shores of Ireland. Sand-banks, too, are numerous, and render it a perilous place for ships. The Wicklow mountains form the great natural feature and beauty of the county, and in Lugnaquilla rise to an elevation over the sea-level of 3,039 ft. The glens lying between the different ridges are extraordinarily picturesque, more especially is this so with Glendalough, Glendaline, the Glen of the Downs, and Avoca, the river of that name reaching the sea at Arklow. The Vale of Avoca is, as everybody knows, the scene of Moore's melody, "The Meeting of the Waters," and it is, indeed, a place of wild, and yet soft and enchanting, beauty—or rather loveliness, for that is the fitter word. The great mountain group which gives such character to Wicklow is a mass of granite protruding through mica and clay slate, and is generally allowed to be one of the most pronounced and best-defined in the kingdom. It is almost needless to add, remembering the position of Wicklow, that it abounds in all kinds of historic interest and remains, and is, *inter alia*, remarkable as exhibiting specimens of all phases of Irish ecclesiastical architecture.

Thus far I have striven in a slight but still faithful manner to give a connected sketch itinerary of Irish coasts, and I think it will be readily allowed that, viewed as a whole, these shores really present many strong attractions for the many among us who, above all things, desire in their recreative endeavours to find something entirely strange and new. No doubt in visiting the western coasts of Ireland the tourist must to some extent make up his mind to resign certain luxuries, and even, perhaps, comforts, to which he has become familiarised, and possibly the traveller may in a material sense be more agreeably located in many parts of the remote Orient, than in some of the unfrequented bays of the far Irish West. But then, *per contra*, nowhere will he behold grander scenery than some of the mountainous cliffs that front and beat back the Atlantic. And inland but a little way, in striking and tender antithesis, are some of the loveliest dells in the kingdom; and that is saying much, as Great Britain has probably more really beautiful valleys than any other country, of anything like the same area, in all the world. The discomfort incurred will soon be forgotten by the true lover of nature in these wild and romantic regions, the extreme western confines of the Old World, and new and delightful impressions will be borne away, which may serve in future to make Englishmen more patient, and even sympathetic, when listening to what once appeared to some of them the absurd and baseless rhapsodies that fire most true Irishmen when expatiating on the natural beauties of the sister kingdom.

THE YOUNG ELECTRICIAN.

By W. SLINGO.

(*Continued from p.* 496.)

A FEW more simple experiments may be performed, illustrating the production of electricity by friction.

Ex. LXXVIII.—The attraction of an electrified rod for liquids may be easily and prettily shown. In a "watch-glass" (obtainable for a penny at chemical apparatus makers') pour a quantity of oil so as to fill the glass, G, Fig. 43. The glass should be raised some distance

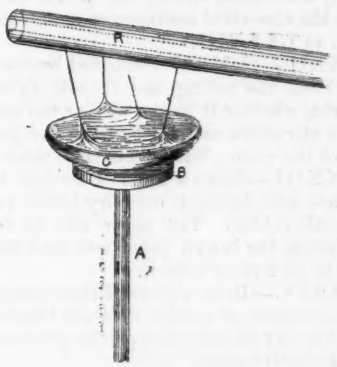


Fig. 43.

from the table, an object which may be accomplished by fixing a 12-in. wooden rod, A, half an-inch thick, in a base-board three or four inches square, and surmounting it by another piece of wood, B, smaller than the watch-glass. On B the glass may be placed, and when the rod, R, is brought towards the oil it will be attracted and drawn up in the manner indicated in the illustration.

Ex. LXXIX.—All these experiments performed with the ebonite, shellac, sulphur, or sealing-wax rod, rubbed with flannel or fur, may be repeated by a glass tube, 2 ft. long, thoroughly dried—made quite hot, in fact—before a bright fire, and rubbed with a piece of old, dry, warm silk. A more copious charge of electricity may be produced by coating the rubbing surface of the silk with a thin layer of an amalgam, made by melting together in a crucible an ounce of tin with an ounce of zinc cut into small pieces and added gradually, stirring continuously with a piece of iron rod. When thoroughly mixed, add two ounces of hot mercury, and repeat the stirring. When these constituents are well mixed, pour the mixture into a warm, clean mortar, and grind with a pestle till cold. Keep the mixture dry. To apply it to the silk apply thereto a very thin layer of the best and clearest lard, rubbing the amalgam over it. The glass tube should, to get the best result, be fused at one end. This, however, is not essential, and is a point upon which occasion to speak will present itself later on.

Ex. LXXX.—With glass the great trouble is the strong tendency it has to condense moisture upon its surface. Now, this moisture is the most plaguish thing we shall have to contend with, owing to the fact that it is a

tolerably good conductor of electricity—that is to say, it is a substance which will facilitate the escape of the electricity as fast as we produce it. The object in heating everything used in these experiments is, then, to expel moisture, not merely to heat the bodies. That heat really plays no part in the production of electricity may be proved by holding the glass rod which has been electrified (after having been dried) in a jet of steam as it escapes from a kettle of boiling water. The glass will become covered with aqueous vapour, but it will be hotter than it was before. Maybe it will be too hot to hold, but all the rubbing in the world will fail to produce the slightest trace of electrification, presuming, of course, that in rubbing we do not altogether remove the water.

Ex. LXXXI.—Get a sheet of stout brown paper, and, cutting off a piece twelve or fourteen inches square, warm it before the fire, making it, in fact, *hot*. With a good and perfectly dry hog's bristle clothes-brush rub the paper (laid on a hot, dry board) briskly. Lift the paper from the board (by taking hold of the corners), and it will be found to be strongly electrified, having the power of doing anything which the electrified sealing-wax or shellac performed (Ex. LXXI. to LXXVIII.).

Ex. LXXXII.—Hold the electrified brown paper near the wall, or even the ceiling, and it will fly towards and adhere thereto, whether it be the wall or the ceiling. This is due to the attraction existing between the paper and the boundaries of the room; but of this more anon.

Ex. LXXXIII.—Make a sheet of foreign, that is thin, notepaper, hot, and, laying it on a dry board, rub it with a piece of bottle-rubber. The paper will be found to be electrified just as the brown paper was, and similar experiments may be performed with it.

Ex. LXXXIV.—Draw a piece of thin sheet gutta percha—say, three-quarters of an inch wide and twelve inches long—between two dry fingers. The percha will exhibit decided evidences of electrification.

Ex. LXXXV.—A still better experiment is to furnish two adjacent fingers with stalls of india-rubber tubing and draw a piece of silk ribbon—say, half-an-inch wide and twelve inches long—between them. The ribbon will be found to be highly electrified, and will cling tenaciously to any substance, such as the arm, table, wall, &c., which may happen to be near.

Ex. LXXXVI.—A solid body may be electrified by friction with a liquid or with a gas. A dry tube exhausted of air, but containing a few drops of dry mercury, when agitated in the dark becomes luminous on account of the electrification set up. This experiment, however, requires the use of apparatus which I have chosen to regard as beyond the reach of our young electrician, so I will say no more about it. I shall presently refer to an experiment which he can easily perform, and which will serve the purpose quite as well.

CONDUCTORS AND INSULATORS.

PR. 2.—Bodies are divided into two classes, viz:—

Conductors, or those bodies which freely transmit electricity, and

Insulators, or those bodies which transmit electricity very feebly; some of them so feebly as to almost approach infinity.

An insulator, then, is a bad or non-conductor, and its prime function in electrical industries is to serve as a means for preventing the escape of electricity from a conductor.

Insulation and conductivity, the properties of insulators and conductors respectively, belong, however, to *all* bodies, but in different degrees. Insulation is never perfect, inasmuch as the best insulator allows some electricity to pass; while, on the other hand, conductivity is never so perfect as to present no obstacle or *resistance* to the passage of electricity. Briefly put, a body which insulates well has *high* resistance and low conductivity, while a body which has *high* conductivity has *low* resistance, and insulates badly or not at all. Conductivity and resistance are, then, the converse one of the other.

It is found that the relative electrical conductivities of different bodies correspond very closely with their thermal conductivities.

Ex. LXXXVII. It will be observed that in the foregoing experiments nothing has been said as to the electrification of metals by friction, for the simple reason that it is impossible to electrify them when held in the hand as the other substances were. This is due to the fact that the hand, body, and metals generally (besides certain other substances) are conductors of electricity, whence, although electricity may have resulted from the friction, it would not be retained on the metal, but would have escaped to, or been neutralised by, the earth; a sequence which always follows under such circumstances. If, however, we insulate a metal rod, that is, interpose an insulating substance between it and the earth or any other large conductor, we can electrify it. Get, therefore, a few inches of indiarubber tubing of the requisite internal diameter, and slip it over a brass, iron, or other metallic rod or tube, say three-quarters of an inch to an inch in diameter and fifteen inches long.

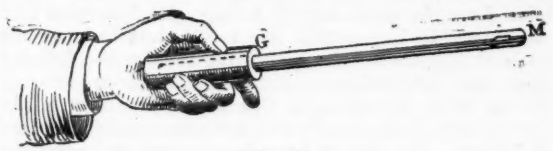


Fig. 44.

Support the metal (M, Fig. 44) in the hand by grasping the insulating rubber-tube, G, and then rub the rod or tube with a pad, consisting of half-a-dozen layers of flannel. The electrification of the metal will ensue.

Ex. LXXXVIII.—Procure four good tumblers, and stand them before the fire until they become hot. Then invert them, and lay a rectangular piece of wood on them, placing a glass at each corner of the wood. An improvised insulating stool (Fig. 45) is the result. Stand a boy on

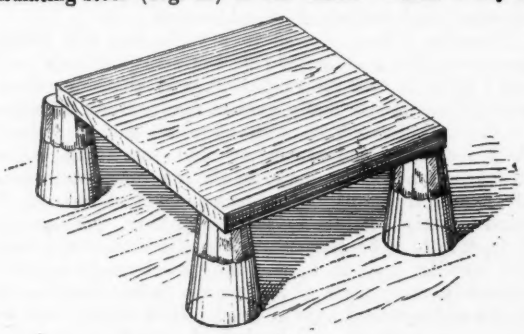


Fig. 45.

this, and beat the back of his coat with a piece of fur or flannel (taking care not to touch him otherwise), and let him present his finger to the suspended pith-ball (Fig. 36), or to a few pieces of dutch metal. Attraction takes place, evidencing electrification. If, now, any one standing on the ground touches him, or if he steps off the stool on to the ground, he is no longer insulated, but the charge

imparted to him vanishes, having been neutralised by contact with the earth.

Ex. LXXXIX.—In Fig. 46 is another, and, perhaps, more useful means of illustrating the difference between conductors and non-conductors or insulators. R is an electrified rod held at such a distance (say, two or three feet) above the pieces, P, of dutch metal, bran, paper, &c., as to be unable to affect them. Let B be a ball of metal, wet worsted, or any other conductor. Then, if we suspend this ball from the rod, R, by a succession of different substances, S, such as cotton, silk, wire, horsehair, &c., we shall be able to ascertain which are conductors and which insulators. The fingers used to hang the strings or threads on the rod R should be insulated by slipping over them finger-stalls, consisting of pieces of indiarubber tubing. It will be apparent that, if S is a conductor, B will become charged, and will act upon P in the same way that R would, were it in B's place. In effect, the interposition of the conductor, S, is to bring the charge on R to the position of B.

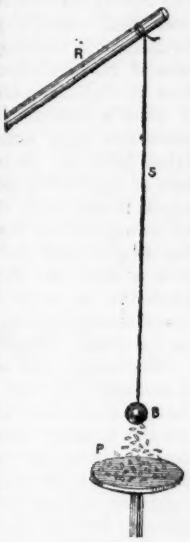


Fig. 46.

Ex. XC.—Electrify one end, A, of a glass tube, and present it to any light, suspended body; attraction ensues. Present the unrubbed, *i.e.*, unelectrified, end, A, to the suspended body; no effect is seen, because the glass being a non-conductor, electricity remains on the part whereon it is generated, instead of distributing itself over the whole substance.

TO STRENGTHEN THE ARMS.

By RICHARD A. PROCTOR.

(*Continued from p.* 515.)

THE biceps is strengthened by the last-named exercises; but this muscle is specially strengthened by all exercises in which weights are raised by bending the arm at the elbow, and bringing the hand towards the shoulder or chest. It is for this reason that bad rowing, in which the arm is bent while it should be kept straight, the rower striving to do with the arms the work which he should do with the back and loins, develops the biceps muscle much more than good rowing. For in good rowing the biceps is only at work during that short and comparatively easy part of the stroke towards the end, after the body has already swung back to the upright position. If the captain of a boat finds that any member of his crew is developing the biceps muscle too rapidly, he may be tolerably sure that there has been too much arm work on the part of that oarsman at any rate. If the whole crew row too much from the arms, the effect on the biceps will be noticeable all round.

Work with the hammer or mallet, especially on a vertical surface, as in hammering nails into a wall, is excellent for the biceps muscles, and also for the muscles at the back of the upper arm. It should be distributed between the two arms, however, or a marked inequality of development will result. Lifting weights with bent arms, pitching weights over the head, and all work in which the arms are freely bent, will be found excellent for developing the upper arm.

No work done by pulling or hauling with straight arms can benefit the upper arm in any appreciable degree.

THE FOREARM AND WRIST.

The exercise which I have found tell most directly on the forearm is that of lifting a chair at arm's length, the chair's back being vertical and the chair held by a handgrip on the lower rung either of the back or front. The grip required to keep the rung from slipping ensures the proper action for developing the forearm, otherwise swaying up dumb-bells at arms' length would be as effective; but when the grip is loosened, in the case of dumb-bells, the work falls as much on the upper as on the fore arm.

A splendid exercise for the muscles of wrists and forearms is to hold the clubs out at arms' length hanging vertically down, the palm side of the wrists being uppermost, and the shoulders of the clubs next to the thumb, then steadily raising the clubs to the horizontal position in a line with the arms, lowering them slowly, raising them again, and so on till you have had enough of the exercise. Another good exercise is to raise the clubs from the same hanging position to the horizontal position at right angles to the arms and turned from the body, carrying them on till they are vertical, then till they are horizontal again, but turned athwart the body, and yet a quarter turn further till they are hanging vertically down. After this carry them back again to their first position, repeating the double movement as long as you conveniently can.

A pleasant relief after the last exercises is obtained by holding the clubs in the same hanging position, but with the shoulders of the clubs next the little finger—that is, daggerwise instead of sword fashion. Work the clubs from this position to the horizontal position on either side—that is, swing them as pendulums athwart the body. Again, holding them rigidly at right angles to the forearm, bend the arm at the elbow till the club is horizontal. Straighten the arm again to the horizontal position; then carry it down to the sides and as far back as you can, still keeping the club held rigidly dagger-fashion.

The broadsword exercise done with a club, first in the right hand, then with the left hand, as described in the preceding article, includes excellent exercise for the forearm as well as for the upper arm and shoulders. It also exercises the wrist finely, especially the parades by which in actual broadsword practice the first, second, and third points, are respectively met.

I used often when a lad at Cambridge to carry in my right or left hand a heavy stick, or a medium sized poker, or even a club, while I walked about my room reading (not always the remarkable subjects which college authorities have selected in their wisdom for the life-training of men). Swaying such implement about with plenty of wrist work I got my wrists, which were never large, so limber and supple, that when I took part in single-stick encounters, I could get in certain wrist strokes with a rapidity which would rather astonish my opponents. In fact an ordinary singlestick feels like a very light switch after a few days' steady use of the exercise with the heavy rods or clubs.

Fencing gives good exercise to the forearm and wrist, especially the movements used in the parades, and still more especially the action in disarming an opponent. Batting, whether at cricket, base-ball, or lawn-tennis, is also good exercise to the forearm.

THE HAND.

The hand requires special exercises to correct the effects of some of the work by which the upper arm, forearm, and wrist are best strengthened. So far as gripping is concerned nothing need be added to what has been already

suggested, for a number of the exercises for the arm and wrist require strenuous hand-gripping. But hand-opening and finger-working exercises are much needed.

Observe that lifting weights by the fingers tends to crook the fingers if the work is done in the usual way, the pressure being against the inside of the fingers. This may be corrected by lifting weights in such a way that the outsides of the fingers feel the pressure. I notice here, by the way, a singular mistake in Mr. Blaikie's advice for correcting the cramped state of the fingers resulting from much hand-gripping work. He recommends the use of the fingers in pushing, as when the body is allowed to rest on the outstretched arms, the fingers pressing against a wall or the floor, and pushing the body back to the erect position. The muscles used in this pushing action are not the muscles which oppose the gripping muscles, but are these very muscles, the hand-closing not the hand-opening muscles. After much work in finger-pushing in this way (that is, by pressure against a flat surface) the hand tends to a hooked and cramped state, not exactly the same as, yet resembling, the hooked hands so often seen among oarsmen.

After all, the hand is more of a grasping instrument than anything else, and we do not find many exercises suitable for correcting the effects of too much gripping work. Exercises in which the fingers are forced open, as in the beginning of the pushing work last considered, and *not* subsequently called upon to resist the pressure by closing towards the palm, are good by actually pressing the hand into straightness, not by exercising any counter muscles.

Here is a simple exercise for the muscles which oppose the gripping muscles:—Place the tips of the fingers under a heavy book, or the nearer half of a writing-desk, then work the fingers as in playing the piano, so that each finger is called on in its turn to lift the weight. A very little work of this kind will go a long way, showing how unusual is such exercise, and how weak and unpractised are the hand-opening as compared with the hand-closing muscles.

THE TEREDO AND ITS WORK.

THE ship-worm—*Teredo navalis*—is a mollusk belonging to the tubiferous bivalves, and has been from time immemorial, and in all quarters of the globe, the subject of comment on account of its ravages in timber exposed to its attack. There are twenty-four species of the teredo, but the ship-worm is the best known of these, although much is yet to be made known concerning it before the information upon the subject can be said to be even approximately complete. Along the Gulf Coast of the United States the worm has been carefully studied by the builders of railroads, and the students have been rewarded more abundantly in that district than those who have examined the subject elsewhere. The results of some of these studies are here presented, and in these results some statements will be found which will prove new and of interest to the scientific world.

"If I had a boring instrument of this sort I would make a fortune," said a recent observer of the teredo. He spoke truly, for such an instrument, should it exist in mechanics, would revolutionise the builder's art. Yet an almost similar one is in daily use under a patent from the Government. The instrument is the flexible shaft-boring machine. It is a spiral of steel having a steel bit at its extremity, revolving with a pulley shaft. The spiral is protected by being run through a rubber hose, so that only the auger itself visibly revolves, and the machine can be handled without danger. The auger bit can be turned in any direction, and as it is revolving at a high rate of speed, can be easily pushed through timber. The first impression the working of this mechanism makes upon the uninstructed observer is lasting. The *Teredo navalis* is a natural reproduction of this instrument, and something more. Its long and flexible body terminates in cutting shells or bits, and is inclosed, for the sake of its protection, in a hose-like shell, which reaches from the inferior extremity to within a very short distance of what is known as the head. At that point the muscles come into play and work the cutters or bit-edges, and so drive into the timber, cutting as smooth and as round a hole as any boring machine yet invented. Like the flexible auger, it can turn itself in any direction; but it has this advantage, it can change its course at any point, whereas the auger, once entered, pushes straight ahead until the hole is bored the requisite depth. An auger that could be guided at an angle from its course after penetrating the wood would be indeed the most wonderful boring machine in the world. Such a boring machine is the teredo.

The teredo first appears in the egg, which is round like a mustard-seed, and so small that a hundred of them will lie in a circle the size of such a seed. They come from a whitish-looking mass just below the stomach of the adult teredo, about one-fourth the distance from the head to the tail, and are in number from one to three millions. These eggs are laid at the beginning of the warm season in the spring, and are deposited from time to time until cold weather sets in. Naturally the worm is most destructive during this warm season. The eggs hatch in the water and give out minute worms about the twenty-fifth of an inch long, and so small in diameter as to be invisible to the inexperienced observer. They swim about for a day or so in the water, apparently enjoying their brief time of adolescence, and then search for timber. They enter this by boring or cutting with the shells or cutters with which each is provided, and the entrance they make is so small that it can scarcely be seen, especially in weather-stained wood. The size of the hole is about that of the period at the end of this sentence.

The worm grows at the rate of about two inches per month under favourable circumstances, and digs a hole to accommodate its increasing size. The length of the hole is, therefore, a guide to the length of the teredo; for it attaches its smaller end to the entrance of its burrow, and pushes forward with the growth of its body. As it progresses, it deposits a coating of lime upon the sides of its cell, the deposit growing thinner as the animal advances, being quite thick at the entrance and merely a film near the head, where is collected a whitish, watery fluid, which probably contains the lime secreted for making the lining of the cell, and perhaps also for repairing the wear of the cutters.

The worm continues its progress for one or one and a half years, and propagates and dies. It is said by naturalists to reach the length of 10 or 12 inches; but they grow much larger than this in the Gulf Coast latitude. The largest one authentically observed was 23 inches long, and five-eighths of an inch thick at the large end. Mr. J. W. Putnam, of New Orleans, from whom much interesting data upon this subject has been obtained, says he found a hole in which a teredo had died, which was three feet long and three-fourths of an inch in diameter at the large end. When grown, the teredo is seen to be a mucilaginous worm, attenuated in shape, extremely delicate to the touch, and tapering to a very small point. The anterior or large end has two bifurcations, provided with horny styles, which close up against each other like shells. These cutters are attached to a pair of strong

muscles, which operate them like forceps or scrapers, the edges of the shells tearing away little chips or fibres of the wood. The continued scraping makes the walls of the cell regular, and time, with the action of water, polishes them smooth. The bore of the teredo, when examined, is seen to be perfectly round, and the surface free of indentations. It is also generally straight, as the inclination of the worm is in the line of the grain of the wood, and is diverted only when the course will project it into the tunnel of some other borer, or when the path leads through hard knots or twists in the wood. The accompanying engraving of the worm (Fig. 1) is about two-thirds of the present size of the preserved specimen from which it was made. The latter was kindly furnished the *Lumberman* by Mr. J. W. Putnam, of the creosote works at West Pascagoula, Miss. It was taken from timber which had been in an arm of the Gulf of Mexico one year, and was 12 in. long when secured, Feb. 21, 1878.

Fig. 1.

It is remarkable with what accuracy the teredo avoids the burrow of its neighbour. There may be hundreds of worms living in the same cubic foot of timber, but they never, even by accident, cut across or into the cavities. It is not known whether in this they are guided by the touch or the hearing, probably both. Coming in contact, during its boring, with wood having obnoxious qualities, the worm avoids it by going around, or it will back down a third of its length, and begin a branch tunnel, previously building a calcareous dam across the abandoned portion of its cell. It will cut within the least possible distance of its fellows, or within a hair's width of the outside of the timber, without breaking the division wall.

Continuing the description of the teredo, however, one will find, just at the base of the cutters, the esophagus or orifice leading into the stomach, in which can be traced the fine sawdust and chips, showing that the worm feeds upon such matter. This is more likely to be food for the worm than the debris of stone which the shell-fish (*Lithophagi*), of the same group as the teredo, have to swallow in the course of their cutting operations. An intestinal canal about the sixteenth of an inch in diameter in adults, and continually growing smaller, extends from the stomach to the inferior extremity. The stomach itself is a dark-looking sac, nearly of the diameter of the teredo, and situated a short distance from the "head." Whether the worm has even a rudimentary brain or spinal chord, and consequently a real thinking, commanding brain, is not certainly known. It is almost transparent, and its interior arrangements can be plainly seen when it is suspended in glycerine or alcohol, but outside of the viscera above mentioned, there is nothing of importance visible. The smaller end of the teredo is attached to the shell lining by a membrane in the shape of a sleeve which closes the entrance hole and prevents water from coming into the cell. This sleeve is provided with two long appendages, file like, which it protrudes, by muscular action, out of the aperture. This is partly an instrument to aid in the removal of the rough and unyielding debris of the wood cut by the worm, and partly a weapon of defence against enemies. Without some such protection a rival teredo or some parasite could enter the tunnel and devour the inmate alive.

The teredo having lived its span, given birth to millions of young ones, closes the outer aperture with a coating of lime, entombs itself, and dies. Often, however, death comes before the allotted time, for so many worms will enter a piece of timber as to eat it up. The whole community, having no future means of subsistence, dies of starvation. Logs have been found cut all to pieces, and filled with half-grown worms all dead. Sudden death also comes sometimes from floods of muddy fresh water. When the Mississippi River broke through Bonnet Carre crevass, muddy river-water flowed through Lake Pontchartrain and Lake Borgne into Mississippi Sound, driving out the salt water as far east as Pass Christian, and the teredos were killed in great quantities. It seems the worm withstands clear fresh-water very well, for at Brisbane, Australia, it is forced to survive the annually recurring exposure to fresh water, lasting from two to three months.

Drying in their cells, the sea water soon penetrates the lime blockades and dissolves the glutinous mass. The shell lining washes out in a few months, and a smooth and gracefully-curved hole remains, a monument of the destructive work of the *Teredo navalis*.

As previously intimated, the teredo may be found in all quarters of the globe, but its ravages are greatest in the warm waters of equatorial seas. This is accounted for by the fact that the summer season is the time of activity for these worms, and the season lasts longer in the southern waters. The teredo has appeared with destructive effect in colder climes, however. It is recorded that in 1731 and 1732 it suddenly appeared in prodigious numbers in Holland, and threatened the country with inundation by devouring the piling of the dykes. The worm bores in any kind of timber, in soft as well as hard, except that of trees of evergreen growth like the palmetto palm. Its work is very rapid. Boats and barges have been sunk in a few days by the penetration of the shells, and solid piles, 12 in. or 15 in. in diameter, have been cut so completely away as to break of their own weight and fall down within six months of the time they were placed in the water. A piece of timber which is completely worm-eaten will preserve its outer surface perfect up to the moment it falls. Close examination of such a sample of wood shows that in the outer surface are innumerable holes about the size of a pin. These are the entrance holes of the teredo; break the wood and it is found honeycombed in cells of from a half-inch to twenty or more inches in length, as indicated in the engraving

Fig. 2.

(Fig. 2), which was made from a section of what appears to have been a five-inch post, or possibly a telegraph pole

In some of the cells will be found the worms, in others nothing but the cutting shells, lying at the large end of the cell, and in others nothing at all to show how the holes were bored. The interior of a teredo-eaten pile looks very much like a rough sponge.

Naturally, where the damage possible to be inflicted by the teredo is so great, every art has from time to time been employed in attempts to counteract the effects. The old method of coppering the vessel's bottom has been long in vogue, and is, of course, successful. It was found impracticable, that is, too costly, to use this method of preserving piling and wharves. It was thought that the timber could be poisoned, and many rank poisons, such as arsenic, strychnine, corrosive sublimate, &c., were tried, but the teredo seemed to thrive as well upon timber so treated as in unprepared timber. Solutions of metals, such as zinc, copper, and iron, were also infused in the wood, but proved of no value for the purpose of defence against the mollusk. Some of the properties of coal-tar have been found effective; but, in the pure state, are so soluble in water as to quickly wash out. It was found by experiment that, when combined with creosote oil—which is a colourless fluid of strong antiseptic qualities, distilled from wood—the properties of coal-tar were practically insoluble in water, and that the oil remains in timber after years of submersion as strong as when first injected. This result seems to be the perfection of prevention, for creosoted piles and timber which have been exposed to the teredo for as many as forty years show no evidence of having at any time been attacked, and are as good as when first placed in the water.

It is impossible to say what there is in creosote oil which makes it destructive to animals of cold blood. It seems to those who have studied the matter that, aside from being obnoxious in itself, the creosote oil so changes the appearance and smell of the wood, that the teredo fails to recognise it as such.—*N. W. Lumberman.*

VIVISECTION.

A LADY who evidently feels very strongly on the subject of vivisection has recently gone to the expense and trouble of sending from abroad a circular addressed to "her" colleagues and fellow-workers "for the benefit of the human race and animal emancipation." She did not confine her kind attention, however, to those and those alone, or else she has been gravely misinformed as to our sentiments, and it may be to this that we are indebted for our copy. This lady makes a startling though possibly not a novel proposition; she proposes the total abolition of vivisection on animals, and would substitute condemned criminals, whom she would solicit as free agents to offer their degraded bodies while still living for the advancement of science as some slight compensation to society for the wrong they have done her. Should they survive the experiments (a point the lady evidently entertains some very serious doubts upon) a free pardon would be their reward. Anæsthetics would be allowed, but not encouraged. The author of the circular touches upon a vexed question when she advances that animals are at least as worthy of protection as men, because having no soul, their lives are doubly precious to them. This is more novel than her first suggestion, and takes some answering—we will not attempt it here. She harrows unnecessarily the feelings of the scientific student by depicting in glowing colours the disgust that would be felt and shown by the "fair pure girl," to whose hand he has dared to aspire, if only his revolting practices were brought to light. This is her *argumentum ad hominem*, and is calculated to act seriously as a deterrent to all but determined bachelors. She holds up to merited opprobrium those operators whose names are published in the "book of infamy," which would seem to be a directory containing their names and addresses, and is anxious under the *lex talionis* to provide for their future unhappiness. The author, in her anxiety to wipe out what she characterises as a "hideous blot" on our fair humanity, occasionally oversteps, like many of her fellows in England, the limits of both courtesy and justice. Looking upon suffering as a means of regeneration, she anathematises those whose profession and pride it is to alleviate it, and condemns its professors to unhappiness in this world and acute suffering in the next.—*Medical Press and Circular.*

FIRST STAR LESSONS.

By RICHARD A. PROCTOR.

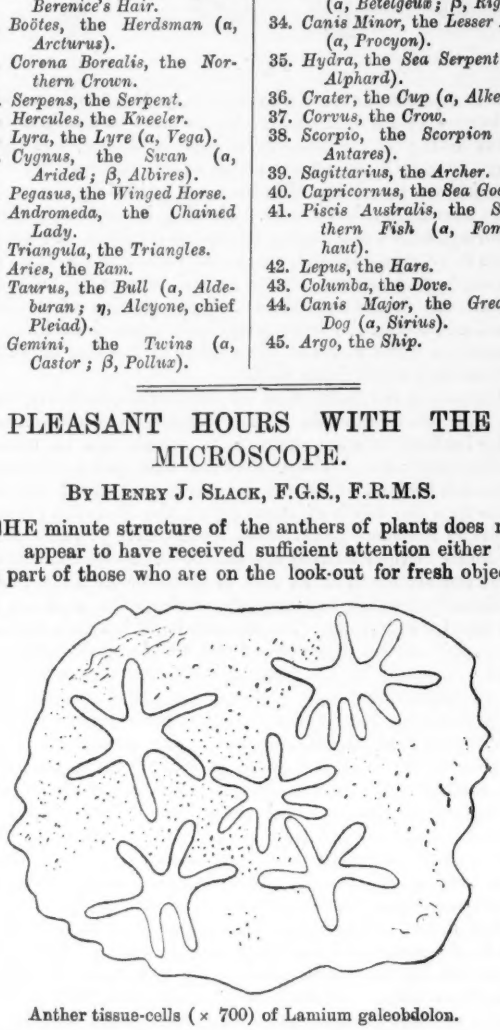
THE constellations included in the twenty-four maps of this series are numbered throughout as follows (the names being omitted on the maps, to clear these as far as possible from all that might render the star-grouping less distinct):—

1. *Ursa Minor*, the *Little Bear* (*a*, the *Pole Star*).
2. *Draco*, the *Dragon* (*a*, *Thuban*)
3. *Cepheus*, *King Cepheus*.
4. *Cassiopeia*, the *Lady in the Chair*.
5. *Perseus*, the *Champion* (*β*, *Algol*, famous variable).
6. *Auriga*, the *Charioteer* (*a*, *Capella*)
7. *Ursa Major*, the *Greater Bear* (*a*, *β*, the *Pointers*).
8. *Canes Venatici*, the *Hunting Dogs* (*a*, *Cor Caroli*).
9. *Coma Berenices*, *Queen Berenice's Hair*.
10. *Boötes*, the *Herdsman* (*a*, *Arcturus*).
11. *Corona Borealis*, the *Northern Crown*.
12. *Serpens*, the *Serpent*.
13. *Hercules*, the *Kneeler*.
14. *Lyra*, the *Lyre* (*a*, *Vega*).
15. *Cygnus*, the *Swan* (*a*, *Arided*; *β*, *Albires*).
16. *Pegasus*, the *Winged Horse*.
17. *Andromeda*, the *Chained Lady*.
18. *Triangula*, the *Triangles*.
19. *Aries*, the *Ram*.
20. *Taurus*, the *Bull* (*a*, *Aldeburan*; *η*, *Alcyone*, chief *Pleiad*).
21. *Gemini*, the *Twins* (*a*, *Castor*; *β*, *Pollux*).
22. *Cancer*, the *Crab* (the cluster is the *Beehive*).
23. *Leo*, the *Lion* (*a*, *Regulus*).
24. *Virgo*, the *Virgin* (*a*, *Spica*)
25. *Libra*, the *Scales*.
26. *Ophiuchus*, the *Serpent Holder*.
27. *Aquila*, the *Eagle* (*a*, *Altair*).
28. *Delphinus*, the *Dolphin*.
29. *Aquarius*, the *Water Carrier*.
30. *Pisces*, the *Fishes*.
31. *Cetus*, the *Sea Monster* (*o*, *Mira*, remarkable variable).
32. *Eridanus*, the *River*.
33. *Orion*, the *Giant Hunter* (*a*, *Betelgeux*; *β*, *Rigel*).
34. *Canis Minor*, the *Lesser Dog* (*a*, *Procyon*).
35. *Hydra*, the *Sea Serpent* (*a*, *Alphard*).
36. *Crater*, the *Cup* (*a*, *Alkes*).
37. *Corvus*, the *Crow*.
38. *Scorpio*, the *Scorpion* (*a*, *Antares*).
39. *Sagittarius*, the *Archer*.
40. *Capricornus*, the *Sea Goat*.
41. *Piscis Australis*, the *Southern Fish* (*a*, *Fomalhaut*).
42. *Lepus*, the *Hare*.
43. *Columba*, the *Dove*.
44. *Canis Major*, the *Greater Dog* (*a*, *Sirius*).
45. *Argo*, the *Ship*.

PLEASANT HOURS WITH THE MICROSCOPE.

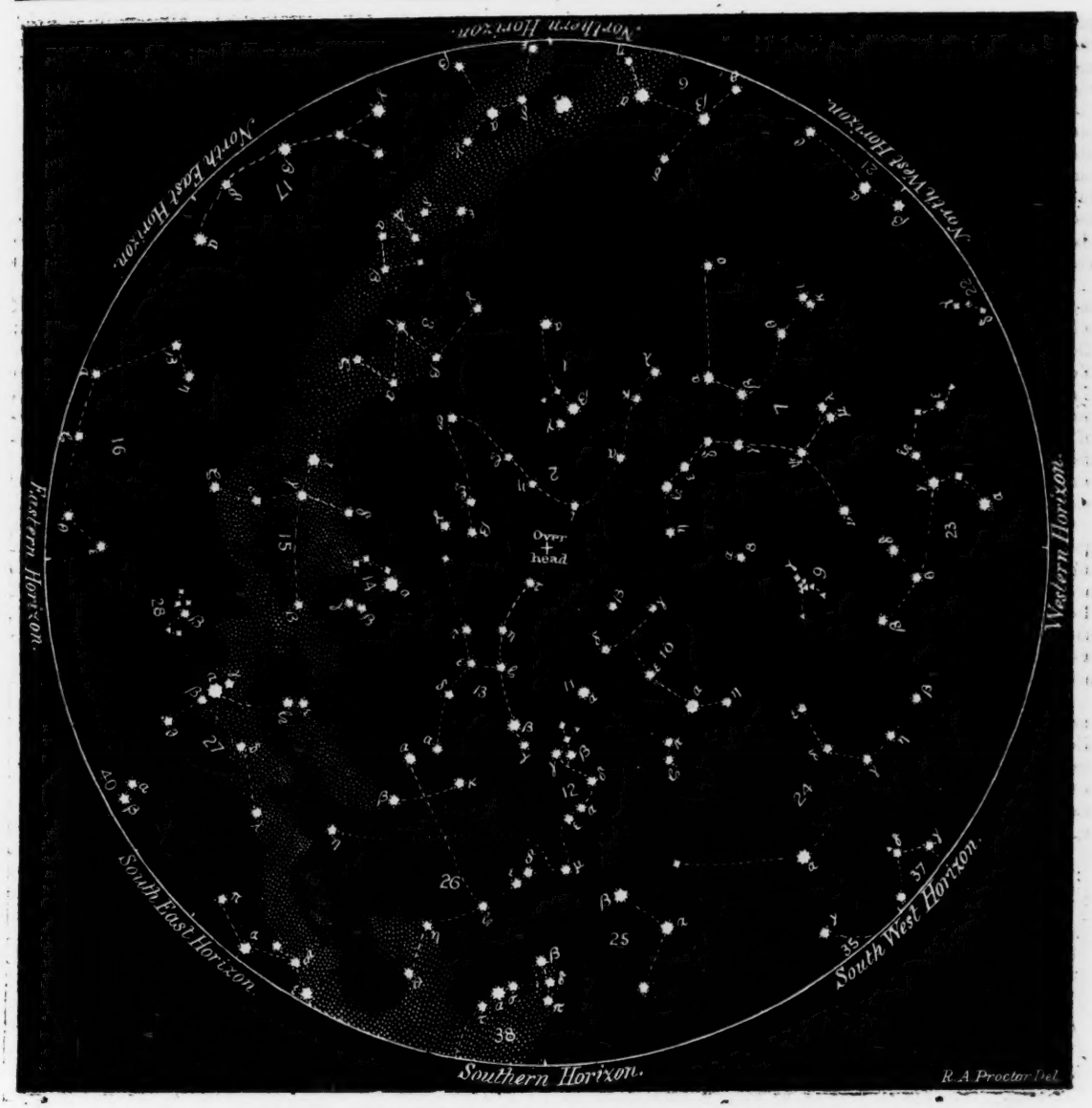
By HENRY J. SLACK, F.G.S., F.R.M.S.

THE minute structure of the anthers of plants does not appear to have received sufficient attention either on the part of those who are on the look-out for fresh objects



Anther tissue-cells (× 700) of Lamium galeobdolon.

of beauty, or on that of the morphologist. Most observers who look at anthers content themselves with doing so with low powers, that suffice to show whether the pollen is dis-



NIGHT SKY FOR JUNE (SECOND MAP OF PAIR),

Showing the heavens as they appear at the following hours:—

June 18 at 10¼ o'clock.	June 26 at 9¾ o'clock.	July 3 at 9¼ o'clock.
June 22 at 10 o'clock.	June 30 at 9½ o'clock.	July 7 at 9 o'clock.

charged through porous slits or curiously opening doors. In former papers attention has been called to some of those more obvious peculiarities, and it may suffice now to point to azaleas and rhododendrons as well worth examination for pore openings, and the berberries for door ditto. Going to a recently-opened azalea, the stigma is found wet and sticky, quite ready for pollen, but the accompanying anthers are still closed, so that fertilization must come from insect-brought grains of another flower. The anthers of a flower that was in bloom some days ago show their two terminal pores very plainly open, and the pollen coming out.

Beginners may be reminded that stamens are the male organs of flowering plants, and they consist of two parts: first, the filament; commonly a simple slender stalk, but sometimes stout, and often ornamented with lateral appendages; and at the top of these come their anthers, which form the pollen-grains by an internal growth. The pollen-grains are equivalent, as Sachs says, "to the microspores of the higher cryptogams.

When the pollen is quite ripe it is easily detached, and if all is washed away the character of the cells that constitute the anther-tissue may be exhibited by carefully opening it in a drop of water on a slide, and putting a cover-glass over it. A half-inch power with first or second eye-piece will suffice to indicate whether the anther-cells

present very remarkable appearance, differing from those of the filament, and if that seems the case, a much higher magnification should be employed. The annexed figure represents the anther wall-cells of the Yellow Lamium (Deadnettle), *Lamium galeobdolon*, an easily-recognised plant of the Labiate family now in flower, and said by Bentham to be not uncommon in England and Ireland, but rare in Scotland. The cells are thicker together than in the sketch. They project a little in a slight convexity, but their finger-like prolongations are lost in the tissue, and this distinguishes them from stellate hairs, which they resemble at first sight.

These stellate cells are by no means common to the anthers of the whole labiate family, but it would be worth while making an extensive search for them. The Red Dead Nettle has peculiar cells, but not like those of the Yellow Lamium. That pretty garden bushy plant, *Coronilla Emerus*, now covered with thousands of yellow, pea-shaped blossoms, has anther-cells something like those of the Yellow Lamium. Laburnum differs, and so does the Judas Tree. Both should be looked at, but none the writer has examined are as pretty as those figured on previous page.

Objects of this delicate character may be preserved in good condition for many days, without any special mounting, by putting them in a drop of saturated solution of acetate of potash with a cover-glass over. This salt is so deliquescent that its solution does not dry up by exposure to the air on any but very dry days, and in ordinary weather it absorbs enough moisture to keep itself in solution.

The botanical morphologist may be interested in noting cases in which the anther-structure differs from that of the filament, and, so far as the writer knows, this subject has been neglected hitherto. Stellate hairs are common to many plants, and the stellate cells of rush pith are well-known objects. If any reader discovers any remarkable anther wall-cells, the writer will be glad to know of them.

TRICYCLES IN 1885.

BY JOHN BROWNING.

(*Chairman of the London Tricycle Club.*)

ROUTE CARDS, A ROUTE BOOK, AND A ROAD BOOK.

AS the season is now well advanced and we are enjoying a spell of fine weather at last, I trust that nearly all who take an interest in these articles are provided with machines. I therefore propose to write a short paper on Route Cards and Road Books, and to follow this with others on Diet and Clothing for tricyclists.

In my last article I alluded to Route Cards; a very complete set of these has been drawn up by Mr. R. E. Phillips.

A great advantage of these cards is that one or more of them can be carried in the rider's pocket and consulted at any doubtful points on the journey, often without stopping the machine. Of course, they have another advantage also, that of extreme portability—half-a-dozen of them, which will cover a distance of 300 miles, occupying no appreciable space when they are required for a tour, and they have to be carried in the necessary luggage.

These Route Cards show the distance from place to place, as well as the whole distance, in both directions, and the places to which all cross-roads lead, as well as their distances, with other information. The cards are sold at twopence each, and a general index is published to them.

Within the last few days Messrs. Letts & Co. have brought out the first part of a new "Route Book of England," by Mr. Charles Howard. The work will be published in three parts, called Southern England, Middle England, and Northern England. The part just issued, Southern England, includes from London to the Land's End. Both direct roads and cross roads are given. The routes are shown in this book on a plan similar to that of Mr. Phillips' Route Cards, the name of each place being given, with the distance from the preceding place, and the whole distance from the starting-point on the right hand of each page, and the distances in the reverse direction on the left hand, for use when riding the other way. The names of the principal hotels are given, and dangerous hills are indicated.

This route-book is furnished with a good road map, and an index of thirteen pages; it is bound in a limp cover; the corners of the cover, and even the corners of the leaves, are rounded, so that it may be slipped easily into the pocket without becoming dog's-eared. When I add that the book is published at one shilling, I think I shall be justified in adding that no greater boon could well have been offered to cyclists by an enterprising publisher.

Those who wish for the most complete information on the condition of the roads, their contour, surface, and mileage, and the places of interest in each locality, in England, Wales, and a great part of Scotland should obtain "Howard's Road-Book," by the same publisher. This work contains topographical notes of the chief towns and cities, and references to the antiquities, natural curiosities, and places of interest along the various routes. It is necessarily rather large to be carried about, but it is invaluable for consultation at home. I have used it extensively, and always found it accurate.

Editorial Gossip.

YET another of the enormous fires which appear to be rapidly becoming chronic, on the premises of Mr. Whiteley, of Westbourne-grove, serves to emphasize what I have on two or three occasions insisted on here, the very unscientific character of our appliances for dealing with anything like a serious conflagration. Between 5 and 6 a.m., the outbreak is first detected by the resident fireman on duty, and, rather more than four hours later, an acre and a half of buildings are converted into an amorphous mass of charred and seething ruins. And it is particularly to be remarked that "there was a plentiful supply of water, and by the aid of eighteen steam fire-engines, three standpipes, and four hydrants, the fire was"—prevented from destroying more than £150,000 worth of property! Any impudent scientific quack nowadays appears to have but little difficulty in getting a "Committee" appointed and subsidized from the National Exchequer. Would it be asking too much if the Government were requested to form one consisting of three or four men of the stamp of Sir F. Abel, Dr. Armstrong, or Dr. Guthrie, to examine and report upon the known chemical means of averting such a disaster as, at one time on the morning of the 17th, threatened the whole of Westbourne-grove?

IN another column will be found a paragraph taken from our contemporary, the *Medical Press and Circular*, and containing a suggestion which is perfectly charming in its simplicity. It emanates from a lady who is so gravely exercised on the subject of vivisection of the lower animals as to propose that physiological experiments on them should be absolutely and entirely put down by the strong arm of the law, and that condemned criminals (!)

should be substituted for them by the experimenter. "One day," says the veracious American legend, "Billy come home a holdin' a little mole by the tail wich some boy had cot and give him, and it was a live. Wen my sister see him she said, 'O, you crewel, crewel boy, thro it in the fire this minnit!'"

THE art of advertising has been developed in this country to an extent which is nothing short of marvellous, and seemingly the old-fashioned method of merely announcing the name and address of a tradesman bids fair to become as extinct as the Notornis. Mr. Samuel Weller expressed his conviction that "the great art o' letter writin" was that the recipient should "vish there wos more." The aim of the advertiser of the present day would seem to be that his reader should get very nearly through his announcement under the settled conviction that it relates to some wholly different subject. We are all pretty familiar with the form of advertisement which begins "Soon after Wilkes was returned for Middlesex in 1768," and through which we wade in the hope and expectation of arriving at some piquant anecdote of social or political life during that part of the reign of George III., only though to be pulled up in disgust at the end with a recommendation to purchase "Smith's Improved Stomach-Warmer," or the like. Or a single wholly unintelligible word, such as "Botibol" or "Pratilique," is repeated in an isolated form, week after week, ultimately to blossom into the announcement of a new liqueur, or something of that sort.

ONE of the greatest misuses of advertising, though, that I remember to have seen lies before me as I write, in the shape of a pamphlet endorsed "A Costless Appeal," the "Appeal" in question being ostensibly one on behalf of a hospital (which nothing shall induce me to specify), but which is indeed and in truth a sequence of advertisements of the businesses of five firms of tradesmen (whose names wild beasts should not tear from me), who have paid for the whole thing out of their own pockets. I do not blame the tradesmen so much as I do the officers of a charity who lend themselves to such tactics as these. Charity and commerce, benevolence and business, surely were never more ill assorted than in this pseudo-begging petition. I was about to express a hope that both sets of people concerned in the production of such a canting type of appeal would meet with the success they deserve; but I forbear, because I believe that in that case some poor creatures might have to forego such benefits as the hospital affords them.

APROPOS of advertising, I am infinitely amused at the "dodges" practised by people to obtain gratuitous puffs and announcements in these columns. Persons, for example, who have invented something write and ask me to describe it, and casually mention that they want to sell their patents and so on. Two journals, too—one a "spiritualistic," and the other an earth-flattening one—have been perfectly frantic in their endeavours to provoke me into a discussion by the grossest abuse—of course, for the sake of the publicity to be obtained through the appearance of replies in KNOWLEDGE. But surely in vain the net is spread in the sight of any bird.

ANOTHER of those instances of heroism in humble life and exhibitions of splendid physical and moral courage under circumstances peculiarly adverse to its exhibition, of which Englishmen may so well be proud, is supplied by the story of the "Gaffer" Worrall in the ghastly explosion which took place in the Clifton Hall mine on Thursday week. Something like a third of a mile below the surface of the earth, in the blackness of a darkness which might be felt, this most gallant fellow, on recovering from the state of insensibility to which he had been reduced by the explosion, manfully stood in the way of the unfortunate creatures who, bereft of their senses by the catastrophe, were blindly rushing to certain death; and, turning them into the only possible way of escape, saved the lives of every man and boy in that part of the mine under his special supervision. Surely if anyone ever earned the Albert Medal this poor "underlooker" should bear it on his breast.

THE occurrence of a pretty smart shock of earthquake in Yorkshire last week, taken in conjunction with the more severe one in Essex in April, 1884, suffices to remind us that even in this country we can be no more assured of immunity from these mysterious terrestrial convulsions than elsewhere. A line drawn from Etna and Vesuvius to Hecla and the volcanic regions of Iceland passes through the British Islands, and at any time a subterranean disturbance along this line may affect us. Prior to our experience last year in the eastern counties, nothing like a considerable shock had visited us since the year 1750, and that which then created such a universal scare, was slight as compared with some which the old chroniclers record. If we may credit Holinshed, flames issued from the earth on the Monday preceding Easter week in 1185, while in 1247, on Feb. 13th, an earthquake did great damage in London. On Sept. 12, 1275, a shock entirely destroyed St. Michael's Church at Glastonbury; while on April 6, 1580, part of the Temple Church fell down, and stones were dislodged from St. Paul's Cathedral from a similar cause. In fact, I might fill this column with similar records; but enough has been said to show that if familiarity with stable ground has bred contempt for danger, such danger nevertheless does exist, remote though it be.

THE popular weekly, *Choice Chips*, is now published by Mr. Joseph Hughes, of Ludgate-hill, London. It is edited by Mr. W. Davenport Adams, who may be trusted to make it a thoroughly readable miscellany.

ALAS, another poor Yorick! Mr. Justice Kay, on Saturday, ordered the winding up of the Hammond Electric Light and Power Company, a meeting of the shareholders having decided that it could not continue to carry on its business.

THE Italian Government has ordered from the Pratt & Witney Company, of Hartford, Connecticut, a hundred Gardner machine guns. Competitive trials have recently been made in Italy, and the preference was given to the Gardner gun, "not upon the rapidity of firing, but upon the simplicity, durability, and certainty of action of the mechanism."

THE UNITED TELEPHONE COMPANY'S BILL.—The United Telephne Company, Limited, has withdrawn its Bill, deposited for the purpose of obtaining parliamentary authority to carry wires for telephonic communication over or under houses, streets, or highways, within 100 miles of the General Post-Office. Against this Bill no fewer than forty-seven petitions had been presented, most of which were from local boards and other governing bodies, including the Metropolitan Board of Works and the Corporation of London.

FIRE AT THE INVENTIONS EXHIBITION.—The secretary of the United Asbestos Company writes, pointing out, in connection with the above fire, that in no portion of the buildings burnt had the Asbestos Fireproof Paint been applied, and the great probability that if the paint had been applied to the woodwork in the roof near the flues where the fire originated, the disastrous fire would not have occurred; and, further, that a portion of the exhibition in greatest danger from the fire, known as Duval's Refreshment-rooms, and enclosed in the E-shaped burning mass of buildings forming the India Museum, was no doubt protected from fire by reason of the wooden walls having been coated with the paint.

XUM

"Let Knowledge grow from more to more."—ALFRED TENNYSON.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the EDITOR OF KNOWLEDGE; *all Business communications to the* PUBLISHERS, *at the Office, 74, Great Queen-street, W.C.* IF THIS IS NOT ATTENDED TO DELAYS ARISE FOR WHICH THE EDITOR IS NOT RESPONSIBLE.

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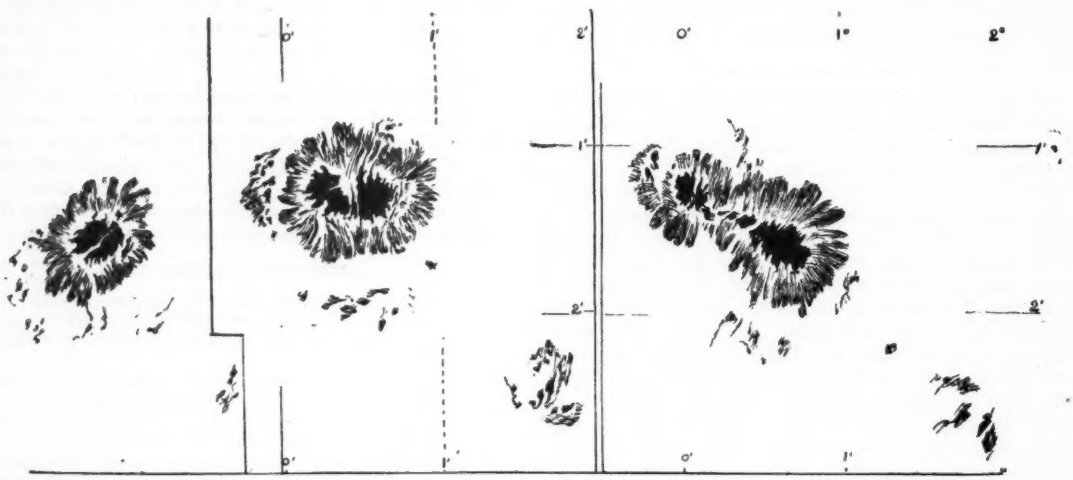
NO COMMUNICATIONS ARE ANSWERED BY POST, EVEN THOUGH STAMPED AND DIRECTED ENVELOPE BE ENCLOSED.

THE RECENT LARGE SUN-SPOT.

[1778]—The splendid spot on the sun's disc last month has been succeeded by two other fine ones. I enclose drawings of the most important, to show the rapid change that occurred in the short interval of two days. This spot appeared on the E. limb on the 6th of this month.



8th June, 6.40 p.m. (Power 60—Direct). 9th, 7 p.m. (Power 120—Direct). 10th, 6.15 p.m. (Power 120—Direct).
Showing the change in the interval of two days. Aperture, 3½ in. Wray.

On the 9th, the definition being good, the fine runs (?) of faculæ through the penumbra were very distinct; at 9 a.m. there was a bright and sharply-defined tongue, stretching well towards the central mass of faculæ; at 1 a.m. only the faintest trace of it could be seen. On the 10th, at 6.40, on the squared disc of the screen, in extreme length it appeared fully 1′ 30″. To-day, the 12th, it is divided into two fine spots; the largest is 1′ in length.

From April to present date, the fine groups and spots we have had are, I think, for size, variety, and general interest, fully equal to those of last summer. G. L. BROWN.

Stirling, June 12.

LUNES.

[1779]—In reply to Mr. Mackie (1745) I certainly do not *believe* the Arcadian's tradition of their pre-lunar origin; I wrote "this of course is an extravagant paradox." But a man may believe it, if he likes; there is nothing impossible in it. It is not an origin "within the traditional memory of man," if by that is meant the *ascertained* length of tradition; this, however, does not bar the possibility of a fact being so handed down, say, ten thousand years. I believe the flaming sword of Eden to be a mythic tradition of an actual occurrence; and that would go even further back. The Arcadian assertion was hardly a "myth," in our sense, though no doubt a *mythos*.

The High Rocks at Tunbridge Wells, at any rate, do not discredit it; for they must have been abraded in almost historic times; and not by tides so much as by storms: their face is peppered by spray-drops as by small-shot. (One would say, indeed, that the stone must have been soft, or the spray corrosive, to make such marks.) Besides, the sun raises tides also.

The moon's diameter is one-half that of Mars, two-thirds that of Mercury. No one, therefore, could see any incongruity in her journeying alone, as we do see in the case of the asteroids. In a word, she is the only attendant orb that is not a mere speck compared with its "big brother." Mr. Proctor has called her a "companion planet," to emphasize this peculiar proportion. She is big enough to bear a drama like our own history; none of the other satellites are,* or the asteroids.

I am at a disadvantage in having no books to refer to as to Mr. Mackie's figures *re* aqueous vapour. He may be right in saying that all the water we see through in the air, would, if condensed, be much less than a foot in thickness; but I guess that condensation is not essential to its blueness becoming visible. We look through many miles of closely-packed spherules (or bubbles) of distilled water; and this may very likely show the colour. A Scotch or Irish mountain looks very much bluer than a French one: I should say because of the greater humidity. Nevertheless, since water is itself nine-tenths oxygen, this may well be blue, as Mr. Mackie thinks.

What I meant about oxygen, *re* Mars, was that his air may be *all* oxygen, or thereabouts; in which case he would be far more life-sustaining than we ever were.

There is no "argument" in my *may-bes*. My *argument* was that aqueous vapour proves heat enough for life.

Mr. Proctor has described the earth as being "greenish-blue" when viewed from the moon.

Does Mr. Mackie mean to say that oxygen and hydrogen cannot be frozen? *We* have barely got oxygen to the fluid state, and *suspect* we have solidified hydrogen when alloyed with palladium; but surely all matter can be either solid, liquid, or gaseous. The cold of space, I fancy, would solidify oxygen; or anything else.

I cannot conceive any reason why the Pyramids should not last as long as the earth itself. The pyramid is the solid of greatest stability; they are therefore more durable than any hill. In an airless, waterless world, like the moon, what could destroy our great human works? Nothing, but the alternate roasting and freezing of day and night. Would that alter general outlines, such as ramparts, river-beds, &c.?

* Jupiter's Satellites vary in diameter from 2,200 miles (the IInd) to 3,700 miles (the IIIrd). This latter is really not so very much smaller than Mars, while Saturn's Satellite, Titan, is notably larger than Mercury.—ED.

In 1871 I saw in the *English Mechanic* a drawing of an apparently straight cut between two lunar lakes, which it was suggested was quasi-human work; but it may be merely a crack; further information seems requisite.

Regarding Mr. Mackie's other letter (1755) I do not think it correctly represents what I wrote; part of it I do not understand; and the rest seems rather a courteous effort to help me out of a hole, by the apt attachment of a cosmical donkey who finds himself "unbeknownst" equidistant from two equally fascinating bundles of solar system, between which he (as I understand) trots up and down while humming (to the music of the spheres)

"How happy could I be with either
Were t'other fair charmer away!" *

I half fancy Mr. M. has got the wrong tortoise by the ear in the Achilles hypothesis.

A magnet will take up iron only *pro ratâ*, and so long as gravitation does not prove stronger. I do not think it is the poles exactly which attract the needle: not even the magnetic poles.

Many scientific men are of the opinion that the regions of space are traversed by "magnetic currents." Also, that there are milestones on the road to Dover. I hope this may make matters clear.

HALLYARDS.

P.S. In my letter (1757, P.S.) *pleni*-presence should be *pluri*-presence—a theological term, chiefly used of Satan (because *omni*-presence is an attribute of Diety). I think you have rarely printed a letter more *delightful* than that of "Commentator" (1750). But let me assure him I do not *disclaim* special creation of man any more than I affirm it. I simply confess I know nothing about it. I think Professor St. George Mivart has admitted that it is not of the essence of Christianity; and he is certainly an uncompromising Christian. One phrase of "Commentator" rather puzzles me:—"The excess are cut off, but, on the whole, there is room for all." I think there must be a meaning in this. H.

THE COLOUR OF THE MOON IN A LUNAR ECLIPSE.

[1780]—The following account of Observations of the Lunar Eclipse of October 4 last, made by Mr. James Smieton, of Broughty Ferry, possesses considerable interest in connection with the discussion on the Ruddy Eclipsed Moon which has recently been carried on in these columns:—

"On turning to some notes made at the time, I find that, about the middle of the total phase, the moon appeared to the naked eye as a dim bluish-grey globe, not unlike a nebula or tailless comet. Its apparent, size, too, seemed greatly diminished." (This last remark does not accord with my recollection.) "Seen through the telescope, the details of the mountains could only be made out near the edges, as the centre of the disc was shrouded in an almost inky blackness." (Neither does this accord with my recollection, as I saw the disc through the telescope all of a uniform, putty-like, dirty-white colour. His station was a full mile to the eastward of mine.)

"About 10.20 p.m. the eastern edge began to brighten, and a faint ruddiness for the first time showed itself. This state of matters continued with little change till 10.45 or so, when, just as the total phase was passing off, a brilliant streak of silvery-blue light encircled the eastern limb (of the shadow), while the rest of the disc glowed with the most delicate tints of lavender, green, and pink. The order was as follows:—Next the streak, lavender, then greenish-blue, then apple-green, then pink, the latter colour gradually blending into a coppery haze that covered the western part. It may be noted that the ruddy tint which first appeared on the eastern side gradually passed westward with the progress of the eclipse. I have no doubt whatever as to the appearance of the ruddy tint *after* the middle of the total phase, though why it should not have manifested itself earlier is difficult to explain."

The explanation, I think, is that the cloud which hid the earlier progress of the eclipse from our view gradually thinned out; first there was a dense cloud and total obscurity; then a thick misty cloud, and the disc seen of a dirty white colour; then this mist getting less dense, and, as the light of the moon began to show on the north-east of the umbra, a faint copper colour gradually spreading itself over the moon; and, finally, the mist still clearing, the beautiful blue arc fringing the umbra and delicately shaded, as my friend describes. The faint indication of moonlight on the north-east, and the first appearance of the copper colour, being exactly coincident, seemed as if the one was the cause of the other; but I fancy this could not be (?). SENEX.

* A neat adaptation of the old schoolmen's definition of Nothing —*Chimæra bombitans in vacuo.*

ON REFLECTION.

[1781]—As regards the reflection puzzle of "M. T. H.," already noticed by myself and other correspondents, does it not follow that if light be due to waves produced in a medium actually present, and if reflection be merely a change in the direction of such waves, due to their falling upon a surface which they do not penetrate, the waves must travel in the new direction (*i.e.*, reflection must occur), whether an eye be present to perceive them or not?

W. H. G.

INFINITE DIVISIBILITY?

[1782]—"Hallyard's" letter (1,747) still cannot get over the infinitely divisible atom. I am in the same predicament: there ought to be a limit. The difficulty consists in this: If I have an "atom" or "any quantity" of matter, I can "halve" it. Of course, the half can be divided again, and so on; but my reason cannot follow. Why? Because it is "limited," "finite"; but logic tells me that there must be "infinite" division "possible" if there can be "infinite" multiplication, or else mathematics have no meaning; although it is not practicable to deal with "infinity," either small or large. Let "Hallyards" endeavour to calculate how many "mathematical" points would make, say, half-an-inch! F. W. H.

HAECKEL ON MIND.

[1783]—If Mr. H. A. Bulley, letter 1764, will read Haeckel's "Pedigree of Man" (there is an English translation) he will find him neither an "extreme" materialist, nor "denying dogmatically." Haeckel certainly denies various dogmatic assertions, which, from their very nature, are impossible of proof either by experiment or reason. All the theories set forth are endeavoured to be explained by reason of empirical proof, logic, or probability. And surely it must be more satisfactory to explain phenomena in a natural, reasonable way, than by the "assumption" of the supernatural and the miraculous.

My simile of mind, with the "scent" of a flower or the "reflection" in a glass, was meant to show that "mind" is a *res media*, a resultant, an effect of two material agents, in itself intangible yet real. As the scent proceeds from the living flower by the influence of sun warmth, so thought proceeds from the living brain under the influence of stimuli. Or as the picture of an object in a glass is intangible yet real, so is mind, thought of an object, in the brain real yet intangible.

Therefore it appears to me that if one or other of these factors is absent or inactive, the effect in the soul or mind goes also.

In conclusion, Haeckel does not deny the existence of "soul" as a persistent, imperishable "force" in nature. On the contrary, he says, All nature, *i.e.*, all "matter." At all events, all organic matter is, in a sense, gifted or possessed of a soul.

Since whatever is, was, and will be, there can be only "change"—constant, unceasing, varying change, as it seems to me, in one endless, ever-revolving circle. I would alter the words quoted of Montaigne, Man works according to the causes that work upon him. F. W. H.

THE IMMANENCE OF LIFE IN MATTER.

[1784]—If "Commentator" will read Haeckel's "Pedigree of Man" he will find that this follower of Darwin *does* postulate what "Commentator" calls "self-existence" to all matter; innate, inherent, self-existent energy, which all matter, organic and inorganic, is everywhere possessed of. There is a "soul" in everything; matter gravitating moves of its own accord, magnetic iron attracts or repels, as do bodies electrical attract or repel each other. There is chemical affinity, the elements of one compound separate by contact with another, form fresh combinations, &c.—in short, the energies of matter are only at present beginning to be somewhat understood. As to that convenient progenitor, at least all living matter does now begin with simple protoplasm, as embryology most amply demonstrates. Is there a plant, beast, or man which has not had to pass this first stage of existence in its life? There is but one law, and its working seems to me uniform, viz., necessity. If I understand Darwinism aright it means constant "change," constant motion; design, creation, arise first in the human brain, they are "ideas" only; for who designed the "designer," or who created the creator—those convenient names to cover our ignorance?

F. W. H.

IS DARWINISM DOUBTFUL?

[1785]—The probability of any theory being the true one, depends on its power of harmonising a greater number of facts than any previous one of similar pretensions. Darwinism or evolution is admitted by friend and foe to fulfil this condition.

XUM

On applying the principle of evolution to the formation of a worm, I cannot imagine that it was necessary for a worm to be first hard before it got evolved into its present softness. To illustrate this, let "Commentator" take the atmosphere at the present time. In construction, it is a mixture of nitrogen and oxygen in a fairly constant proportion.

But was its constitution always so?

Geological investigations lead us to think that it was not so. If our globe was at one time in a molten condition—and we have no reason to think the contrary—most of the elements which enter into the constitution of organic forms must have existed as separate atoms.

So soon, however, as the temperature of the globe was lowered by radiation, &c., chemical attraction began to assert itself, and, causing some of the elements to combine, hydrogen would unite with oxygen to form water; carbon would unite with oxygen to form carbonic and carbonous oxides, nitrogen with hydrogen to form ammonia, and in all probability a host of hydrocarbons, of nitrogenous, phosphidic, and sulphidic matter, &c., would be formed at the same time.

One of the conditions of stability in a mixture of hetreogeneous molecules is constancy of temperature—an increase or decrease of temperature causing decomposition and recombination.

A lowering of the temperature is accompanied by complexity of organisation in many of the molecules.

For instance, organic matter exposed to destructive distillation affords different products, according to the temperature employed.

To resume. Our ideal atmospheric molecules, under the influence of sunlight, are now passing from a higher to a lower temperature, and molecules which were in harmony before will now cease to be so; decomposition and recombination will take place, resulting in the formation of molecules of greater complexity. These series of decompositions and recombinations would continue until molecules of such complexity would be formed as to entitle them to be regarded as the nuclei out of which all past and present life has been evolved.

The organic remains which form our coal-beds very likely were the agents in decomposing carbonic acid, retaining the carbon in their tissue and eliminating free oxygen. A portion, at least, of the free atmospheric nitrogen was produced by the same agents. Now, "Commentator" will see that the worm, according to Darwinism, is the result of a series of antecedences—in other words—of the organism and its environment. A WELSHMAN.

MR. THOMAS'S "EVOLUTION," AND DARWIN'S.

[1786]—May I be permitted to point out that Mr. Cave Thomas (p. 486), appears to use the master-word, "Evolution," *not* in the sense of the Master, viz.: natural selection? The controversy rotates upon that. May "Hallyards," and your correspondent, *inter alios*, be allowed to claim Mr. Thomas as one of the champions on their side, viz., that of evolution *versus* natural selection—not definitively denying evolution (growth—predestined development by virtue of "the cause, the cause, my soul," infinite reason), but doubting that natural selection is the cause of evolution, as Darwin and his disciples Tyndall, Huxley, and Romanes, positively, not to say, dogmatically, assert?

Darwin's grand object, speciality, and endeavour was to show how evolution came about. In this, his utilisation of the struggle for existence gave him the most brilliant success (I do not say victory), which philosophic natural history has ever witnessed.

How does Mr. Thomas elucidate or prove his proposition; "adaptation to purpose, fitness, resolves itself into adaptation of proposition to purpose; evolution, development, into the becoming of the proportioned in all things?" Who or what proposes? Who or what causes the becoming (*Werden und Werdensein*) "that is the question!" This is our difficulty; but Darwin himself gave no answer to the all-pertinent query, What is the *cause* of variation? and the word, word, word, itself, seems to me utterly feeble and inadequate to explain the marvellous manifestation of the Universe—reason which we label development.

Darwin himself, nor Moses and all the prophets, could get away from DESIGN, meaning teleology, harmony, fitness—not necessarily implying a designer—but, indeed, implying an eternal self-existence, power, cause, reason (Hartmann asserts it to be unconscious).

Again, how far does Mr. Thomas's principle "proportion" differ from the world-old one, harmony, symmetry, no more beautifully shadowed forth than in the world-old sentences, harmony of the spheres, and the morning stars sang together for joy?

We may see the immediate origin of symmetry in the egg, that (by virtue of the cause) divides into *two halves*, and goes on developing symmetrically. It occurred to me some time ago that the pleasure we derive from contrast, *e.g.*, a fleecy sky, and heaven broken up by Nature's leaf-lace, is in reality, in secret, due to harmony of quantitative vibration actually taking place in the eye, as musically in the ear. Does Mr. Thomas endorse this notion?

COMMENTATOR.

P.S.—Huxley himself (it seems rather forgetfully) uses the term evolution in two different senses: Darwin's (natural selection), and the normal one, of harmonious growth.

TERMITES AND NATURAL SELECTION.

[1787]—The case has to be considered why many species of ants, not only termites, develop wings at the end of the season, and why they kill each other. It would *seem* that they have no idea of migrating in part, or laying up a sufficient separate store; *ergo*, as their space and provision are limited, they *must* kill a *quantum suff.* of the community in order that the rest may survive—not all starve together. If this inner necessity exists, I do not see why the fratricidal habit ("cannibal," Huxley calls it, *in re* the crayfish) should not be implanted, or inherent, in the animal, by virtue of, or through the operation of, That Power which is in—which is—All, from the kaleidoscopic crystal up, through the "automaton" animal, to man. I do not, I say, see why it should have had to be "acquired" by natural selection. I cannot conceive how the rudiments of such a habit began. Did it happen to come into the head of one ant, or of many, to kill its brother? or how? I confess the whole origin of natural selection, of haphazard variation, seems to be enveloped in the densest fog. Haphazard variation I do *not* believe in; but, then, if variation took place according to law, *this* is the real *fons et origo* of evolution—the word variation should be dropped, and we should consider all as the manifestation and outcome of predestined development—the incorporation and operation of infinite nature (matter and reason) which I am wont to term in the sublime all-comprising (*all-umfassend*) Hebrew expression, the I AM; viz., all which is—ant, bee, crayfish, and countless other animals, though, not as a rule, up to very man, *kill each other*. Now, will the Darwinians say this habit was "acquired"? I do not believe it. COMMENTATOR.

"ANIMALS OF THE PRESENT AND PAST."

"Mr. G. Allen . . . . has [shown how unfounded is] the idea that in past ages the animals existing on the earth were very much larger than those now known." . . . . "On the whole, it may be doubted whether at any time . . . . the average size of the ten largest creatures by sea and land exceeded the average size of the ten largest species existing at the present day."—R. A. PROCTOR, in KNOWLEDGE, pp. 477–8.

[1788]—"Victrix causa diis placuit; sed victa Catoni." First, Mr. A. speaks of animals existing *on the earth: i.e.* the planet, without distinction of land and water; and Mr. P. adduces huge water-creatures as a proof that earth's brood has not degenerated in size *on the whole*. No one ever denied this, perhaps; but, certainly, the idea which Mr. A. seems to combat is the (undoubtedly) prevalent one that "big animals" were commoner of old than now, *on land*; (who, *du reste*, ever thinks of whales and sharks as "animals"?) and this idea i (please, printer, don't alter this—it is put for a reason)—think is quite correct.

To go no further than *K.* itself—a short time ago there was a cut of an old-world scene, with an ideal (but real) monster surveying tree-tops or mere whin and gorse; while above hovered a Pterodactyl on steady wing, not inferior to him in size.

Where on earth is anything so big to be found now? Even the Peruvian condor measures only 40 feet across the wings,* from tip to tip; and no other bird comes near him. The elephant is *our* biggest mammal; the crocodile our biggest lizard; were not the megatherium, mammoth, mastodon, plesiosaurus, &c., far larger, and *quite as numerous*, if we may judge by their very frequent remains?

It is unfair to lump in the sea with the land, for very obvious reasons. The abundance of animals will always be regulated by their food-supply. Thus, a single family of tigers requires a range equal to half Middlesex to live comfortably. Now, the *surface* alone of the sea is five or six times greater than of the land; *cube* the sea, and I can't even guess how much space will be added for the food-supply of sea-beasts over and above that of land ones. Further, the water is the original habitat of *all* life; no wonder, then, if the finest extant specimens of life should be found *in their native element*. Besides, man is the most cunning destroyer; and man cannot penetrate the sea-depths (destructively.)

Mr. P. says (*loc. cit.*) "It is certain that the great land monsters of the Jurassic age could not exist now. For while their numbers

* This seems an enormous exaggeration.—ED.

must have always been limited, even when surrounding conditions favoured their existence."

Why limited? which of course means "relatively small." How do we know that the land was not very much more extensive then? The seas may have been deeper, thus leaving more bed exposed; or, the earth may have been much greater in diameter in those remote epochs (?). Mountain chains are caused, I believe, by the shrinkage of the earth, and consequent creasing of her hide; the Alps were thrust up in this way in relatively recent times; I fear paradox, but it does not seem altogether incredible that the surface was much greater before the older chains arose. At any rate, the virgin soil, unexhausted by tillage and cities, must have left far larger feeding-grounds for the land monsters than has ever existed in historical times.

Mr. Proctor goes on—"the powers of the human race at the present time would be fatal to the existence of these unwieldy monsters."

How do we know they were unwieldy? I can conceive a savant, ten thousand years hence, concluding that the elephant must have been unwieldy, and that hence he perished. The only way in which we could war with land-monsters would be by artillery; which we have possessed but a few centuries. In the previous ones I think a battalion of Saurians (with its due complement of light *dragons* —Pterodactyls—) would at any time have given a very good account of any human army. (Nearly thirty years ago the Rev. D. Haigh wrote a big book to show that the numerous legends of dragons—St. George's, and the Wantly one, and many another—can only be accounted for by supposing that stray pterodactyls, &c., *did* survive into historical times, and were, in the usual course, masters of the situation. I think this very probably true.)

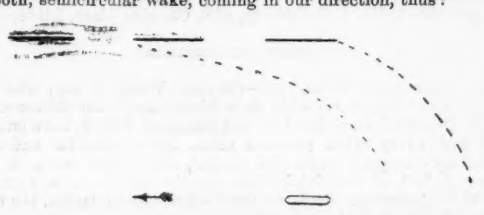
But, not to theorize, has man, even now, ever extirpated anything? In this France, where I write,—over populated, highly cultivated,—keen sportsmen, bent on success—they have been striving for centuries might and main to stamp out, not the Pterodactyl, which could "take a sight" at them from balloon-range, but bears, boars, and wolves. Do what they will, these beasts swarm still. Why is this? France, on the whole, is as flat, cultivated, and populated as England; yet in England these beasts of prey *have* been extirpated. I think the reason is that the climate of France is much more genial and stimulating than ours, thus increasing the fecundity of the fauna. Imagine the tropical warmth and the giant flora of the long-past ages; and it seems rash to hazard an opinion as to the relative numbers of the extinct races.

These become extinct (we can guess) only through failure of sufficient food; the sea has maintained its monsters, because its supplies are far greater; and, if we exclude the sea, it cannot surely be doubted for a moment that our "ten largest species" of beasts would not even *come near the smallest* of the *ten largest of olden time*. See 2 Cor. xi., 19. HALLYARDS.

THE SEA-SERPENT.

[1789]—I quite agree with your remarks in KNOWLEDGE, April 3, 1885: "Much valuable evidence concerning the sea-serpent is suppressed by the flippant sneering of the class of writers who require no other qualification than ignorance of the subject on which they write. Scores—perhaps hundreds—of trustworthy mariners of all ranks, in both the naval and mercantile services, have seen what they believe to be such a creature, but they refuse to publish any account of their observations, knowing they will be insulted and publicly gibbeted as fools and liars if they do." Now for confirmation. On Wednesday, July 12, 1876, we, passengers on board the steamship *El Dorado*, saw off Jebel Zagar, in the Red Sea, the following appearance in front of a bay in the large island.

The three lengths were estimated by Captain T. C. Kerr at 50 ft. each, and they lay in slightly churned water, at the end of a smooth, semicircular wake, coming in our direction, thus:



Every one on deck, and many called up, saw the sight. When we reached the position in the lower sketch the three lengths *sank out of sight simultaneously*, and at the same time a large thresher sprang into the air, and fell back into the water with a great splash.

I at once drew up a narrative of what we had seen, with a sketch, which Captain Kerr and every eyewitness countersigned, and at Colombo posted it to the *Illustrated London News*, who suppressed it, nor could my agents get it published elsewhere.

Last trooping season a local paper, the *Pioneer*, mentioned that the trooper *Crocodile* had seen the sea-serpent off Jebel Zagar (where we had seen it). I sent my narrative in confirmation, and it was suppressed.

The lamented Frank Buckland, in "Notes and Jottings from Animal Life," exhibits on page 402 a woodcut of the sea-serpent as seen in Loch Hourn. The greater part of the animal is figured, but we only saw three lengths. R. F. H.

Morar, May 22, 1885.

LETTERS RECEIVED AND SHORT ANSWERS.

JAMES GILLESPIE. Your facts and figures are alike utterly wrong, and your inferences from them equally fallacious. You ask for my opinion; there you have it as succinctly as I can give it.—COMMENTATOR. Letter on Evolution, &c., in type. The other one suppressed, as calculated to hurt the feelings of living people. Please write on one side of the paper only. Your MS. closely written on both sides of the sheet puts the compositors in a most evil temper, and really does afford a valid excuse for typographical errata.—A. B. Biggs. See p. 486.—ENQUIRER. You talk about "the ordinary equatorial telescope," by which you presumably mean the Fraunhofer, or German form, with the telescope at one end of the declination axis and the declination circle at the other. You will find an intelligible illustration of this on p. 45 of "Simms on the Achromatic Telescope." Your declination axis should rest in Y's at the ends of an arm on the top of and at right angles to the polar axis. At one end of the declination axis is a cradle which carries the telescope, to the other the declination circle (in my own equatoreal) is rigidly fixed so as to rotate with the axis. Its verniers are attached to the fixed frame-work carrying the Y's. I can give no further explanation here without illustrating it with working drawings.—SENEX. All that happens when sunlight passes through sodium vapour generated near the observer's eye is a notable darkening of the already existing D lines in it. Naturally, the more of such vapour the light passes through the more it will be absorbed.—MISS KATE H. CHANDLER. The address at which the Ammoniaphone is procurable appeared on the advertisement sheet of the very number which contained my reply to you. I never see the advertisements myself, and was unaware that this would appear.—H. A. BULLEY. You trench too much upon purely theological ground for me to insert your letter.—EDWARD BUTLER, W. UDAL & Co., RAPHAEL TUCK & SONS. Received.—T. H. ELLIOTT. Wholly unsuited to the pages of a scientific periodical.—HENRY BRETTELL invites the attention of "Hallyards" to the fact that in the XIIIth Chapter of his "Other Worlds than Ours," the Conductor of this journal distinctly states that space must be infinite.—F. W. RUDLER. Received with thanks.—C. E. DOYLE. The Religious Tract Society publish a volume on "Plants," in five sections—"The Seed," "The Leaf," "The Flower," "The Fruit," "The Grass." These are issued separately at a very low rate, and the last section comes the nearest to what you apparently require of any book I am familiar with.—FREDK. T. GOODMAN. I have communicated with the reviewer, who says, "I will copy the title-page of Mr. Wooton's book verbatim. It is, 'Mimosis Inquieta.' By Edwin Wooton. Reprinted from the *Journal of Psychological Medicine*, Vol. VIII., Part 2. Edited by Lyttleton S. Forbes Winslow, M.B., D.C.L., Lecturer on Mental Diseases, Charing Cross Hospital. London: Baillière, Tindall, and Cox, King William-street, Strand." I cannot understand publishers repudiating all knowledge of a work on the title-page of which their names are so conspicuously printed.—HALLYARDS asks Mr. Butler if he can tell him the name of a buff-coloured spider with three depressions on its back, and its body ending in two humps or corners at the sides. "There were," adds our correspondent, "many buff flowers growing on the spot."—REV. S. WAGENHALS. Forwarded.—W. THATCHER. The mean diameter of the earth is 7,912·28 miles; that of the moon 2,163·06. Hence it would take nearly 49 moons to make up one globe the size of the earth. See paragraph in capital letters which concludes those at the head of the Correspondence Columns.

IN consequence of the growing scarcity of lumber, corrugated iron is now being a good deal used in the United States.

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (KNOWLEDGE *being a popular magazine*) *than is accorded by the most excellent trade journals.*

VENTILATING FLUE-BRICKS.

[Patent No. 7,946. 1884.]—The novelty and advantages of these bricks, patented by Mr. A. Talbot, of Manchester, is that by their means flues may be formed in thin walls of either 4½-in. or 9-in. thickness. The flues can be either horizontal, vertical, or oblique. By their means it will be quite easy to have a constant supply of fresh air and the constant removal of the vitiated air. The vertical flue-bricks are formed with a hole through the 3-in. thickness of the brick, nearer to one end than the other, so that by turning the bricks alternately, end for end, the holes will come one over the other, and the bricks bond in with the ordinary bricks of the wall. The flue in a 9-in. wall will be about 7 in. × 5 in., and 8½ in. × 4½ in., and in a 4½-in. wall about two inches diameter. The horizontal flues are formed by making a groove or grooves on one of the faces of the brick; and by placing two courses, one over the other with the grooves together, a continuous flue is formed of about two inches diameter in a 4½-in. wall, and larger in a 9-in. wall. The bricks can also be perforated horizontally, and the holes placed in line with each other would form continuous flues. Oblique flues and all necessary junctions, connections, and openings can be formed. The flues can be formed with socketed or unsocketed joints, and be either glazed or unglazed. The flues are smaller than those generally used for ventilating purposes, but as any number can be used in a wall, that is claimed as an advantage, as many small inlets at different parts of a room will be less liable to cause draughts, and will give a more equable temperature than one or two large flues could do. The system considered most suitable for ordinary living-rooms is to have a fireplace with hot-air chamber at back or sides, supplied with cold fresh air by means of the horizontal flues from the nearest external wall; this air, when warmed, will pass along horizontal flues at the level of the skirting, through which openings will be made in the positions, and as frequently as desired or required by the size of the room, the warm fresh air will thus pass into the room near the floor-level, and rise to the top of the room, where it will be drawn off through openings in the cornice into another horizontal flue which might open to the outer air at the nearest point, or by means of the vertical flues be connected with an exhaust ventilator in the roof, which would always ensure a constant up-draught. By these means, all rooms, halls, passages, &c., can be thoroughly and constantly supplied with fresh air, and the vitiated air be removed as soon as formed. The whole house can also be warmed and ventilated throughout by a system of these flues connected with a hot-air chamber in connection with the kitchen or other fireplace. Public buildings can also be warmed and ventilated in a similar manner by means of a heating-chamber in the basement or other suitable position.

CONCRETE STRUCTURES.

PORTLAND cement concrete (if made with a non-porous aggregate) is impervious to moisture, and yet, at the same time (if not hydraulically compressed) will take up a sufficient quantity of moisture from the air to prevent condensation upon the surface of the walls. It not only resists the disintegrating influences of the atmosphere, but becomes even harder with the lapse of time. It may also be made in different colours, and can be finished off to nearly a polished surface, or can be left quite rough. Nothing, therefore, can be better as a building material.

In order to properly use it, many systems have been devised, but that ordinarily used consists of first forming casings of wood, between which the liquid concrete is deposited and allowed to become hard or "to set." The castings are then removed, the cavities and other imperfections are filled in, and the wall receives a thin facing of a finer concrete. Mouldings and other ornament are also applied to this face by the ordinary plasterer's methods.

In the system patented by Messrs. West, instead of employing wood casings between which to deposit the concrete, or "béton," and removing them when the béton has become hard, *casings of concrete* itself are employed. These casings, or shells, of concrete become a part of the wall, and form a face to the work. They are made in the form of rectangular slabs, the courses of which are secured together by means of a bituminous cement, which (whilst hot) is poured into the keyholes, and which cools immediately and becomes hard. Any other quick-setting cement may be used in place of the bitumen. The horizontal and vertical joints of the slabs are further secured by grooves, into which lime-putty is squeezed, or a cement-grout is poured, and which act as joggles. Grooves are also made in the solid work introduced to form window and other openings, for the same purpose.

If necessary, the use of any kind of cement for the keys may be avoided by altering the form of the slab, by which means the bed-joint of one course toothes into that of the other. For instance, slabs of hexagonal form may be employed, when it will be seen that the joggle-joint is sufficient to prevent the slabs from toppling over or from being thrust outwards by the pressure of the concrete behind them.

The walls built with these slabs may be made so hard that a nail cannot be driven into them, or they may be made sufficiently soft to be used for fixing joinery to them by means of nails.

For retaining-walls, or, in fact, any kind of engineering work, the system may be applied with great economy, the slabs being made proportionately heavy to suit the work.

The use of concrete as a material for building will be found to meet all the defects set forth by practical people, as it may be made fire-proof, vermin-proof, and nail-proof.

WATER-FILTER.

[Patent No. 8,320. 1884.]—The advantage of this water-filter, as shown below, is that the filtering medium can any time in a few moments, and at small expense, be renewed, and the filter is then in every respect equal to new.

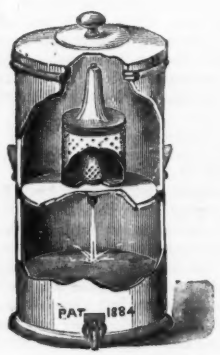


Fig. 1.

Fig. 2.

It will be seen that two concentric cylinders of perforated earthenware, copper, or other suitable material have a common lid and a common base. Between these cylinders the filtering medium is poured in, and the water is filtered by passing through the filtering medium into the space in the interior, whence it issues into the receptacle for filtered water, or is drawn off at once.

The filter is made in a great variety of styles. Fig. 1 represents one of the filters of china or earthenware for indoor use, and Fig. 2 represents another designed for attachment to main service pipes. The patentee is Mr. J. P. Jackson, of 9, Canning-place, Liverpool.

THE INVENTIONS EXHIBITION.—Messrs. Verity & Co., who took the public eye by storm with their Electrolier in the Edison Court of the Crystal Palace Electric Exhibition of 1881-2, have outdone that and every other previous effort by a beautiful and most tastefully-designed brass Electrolier, fixed this week in the entrance hall of the Exhibition, opposite to the now notorious Duval Dining-room. It is to carry eighty Swan lamps, the effect of which will, doubtless, be grand.

Our Chess Column.

By MEPHISTO.

BRITISH CHESS ASSOCIATION.

PLAY in the Tournament of the B. C. A. has proceeded all the week in a most satisfactory manner. Young players are coming to the fore, and surprise their older competitors with unexpected combinations and unlooked-for resources. Up to Saturday last, Bird and Gunsberg were favourites. On that day Gunsberg defeated Bird in the game given below.

In connection with the play of the older masters, we may remark that their play presents a striking contrast in the opening to the play of younger men who follow modern notions and theories. As a rule, the younger player will mostly get an advantage in the opening. If these veteran Chess-players do not readily take to modern principles of development, whose superiority over older lines of play has undeniably been proved, then surely these modern principles could not possibly have been put before the Chess world in a comprehensive and digestible form. We have been impressed with this fact to that extent, that we have determined, after the Tournaments have finished, to begin a series of papers in which we shall endeavour to teach *first principles* of Chess and Chess Openings, not by mere analysis, as heretofore, but by taking for our illustration an actual and well-played representative game of each opening.

We give the latest score below. Chess has more and more become the favourite pastime of the educated classes. Columns of Chess news now find their way in the daily press. As a practical recognition of this fact Lord Tennyson has offered copies of his works as a prize to be competed for by the Church, Army, Medicine, and Law. Mr. Ruskin has likewise given prizes of books for competition by players following science, art, or literature. We shall report the result of these highly-interesting contests.

Complete score of the B. C. A. Tournament up to Tuesday eleven o'clock p.m., inclusive:—

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Total.
H. E. Bird (A)	—	1	0			1		1	½	1	1	1		1		1	8½
W. Donisthorpe (B)	0	—	0				1	1	0	1	1	1		1	0	0	6
J. Gunsberg (C)	1	1	—		1			1			1	1	1	1		1	9
A. Guest (D)				—		1			1		½		0	1	1		4½
Thos. Hewit (E)			0		—	0		1		1	0			1			3
D. Y. Mills (F)	0			0	1	—		0	0		0	1			½		2½
Rev. G. McDonnell (G)		0					—	0		1	1		1	½	1	1	5½
J. Mortimer (H)	0	0	0		0	1	1	—		1	0	1		0		1	5
R. Loman (I)	½	1		0		1			—		0	1				1	4½
W. Mackeson, Q.C. (J)	0	0			0		0	0		—	0			½		0	½
W. H. K. Pollock (K)	0	0	0	½	1	1	0	1	1	1	—			1		1	7½
R. Rabson (L)	0	0	0			0		0	0			—	0	0			0
H. A. Reeves (M)			0	1			0					1	—		0	1	3
Rev. J. de Soyres (N)	0	0	0	0	0		½	1		½		1		—	0	1	4
G. E. Wainwright (O)		1		0		½	0				0		1	1	—		3½
A. Rumboll (P)	0	1	0				0	0	0	1	0		0	0	0	—	2

Game played June 20, 1885.

VIENNA OPENING.

White. W. H. K. Pollock	Black. J. Hewitt.	White. W. H. K. Pollock.	Black. J. Hewitt.
1. P to K4	P to K4	17. QR to Q sq. (*k*)	P × Kt
2. Kt to QB3	B to QB4 (*a*)	18. R to B7 (ch)	K × P
3. P to KB4	P × P (*b*)	19. R × BP	R to K2 (*l*)
4. Kt to KB3	B to Q Kt3 (*c*)	20. R to B8 (*m*)	K to B2
5. P to Q4	P to K Kt4	21. QR to Q8	K to Kt2 (*n*)
6. B to QB4	P to Q3	22. P to B4	P to KR4
7. Castles (*d*)	B to K3	23. P to QKt4	R to K3
8. Kt to Q5	Kt to Q2	24. P to B5	R to K2
9. Kt × B	Kt × Kt	25. P to Kt5	R to K3
10. P to Q5 (*e*)	Kt × B (*f*)	26. P to B6	P × P
11. P × B	P to KB3 (*g*)	27. P × P	Kt to K2
12. Kt × P (*h*)	Kt to K4	28. R × R	Kt × R
13. Q to R5 (ch)	K to K2 (*i*)	29. R × Kt	K to B3 (3)
14. B × P (*j*)	Q to K sq.	30. P to B7	R to B3
15. Q × Q	R × Q	31. R to B8 (ch) and wins	
16. B × Kt	QP × B		

NOTES.

(*a*) This defence gives White many chances. If it is intended to refuse the Gambit which follows on 2. Kt to QB3, then Kt to KB3 is a safe reply for Black.

(*b*) The only advantageous way of following up Black's move of 2. B to B4 is to decline the Gambit by now playing 3. P to Q3.

(*c*) Black is compelled to give way; he loses time in the Opening, which is always valuable; he also deprives his K side of the services of his KB on Kt2, thereby weakening it.

(*d*) The outcome being that White has the ordinary Gambit position, but with a move ahead, and Black's K side is weakened by the absence from Kt2 of his KB.

(*e*) White had nothing to gain by the exchange of pieces and this move.

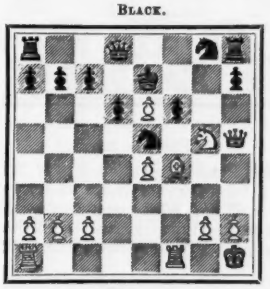
(*f*) B to Q2, followed up by Q to B3, looked more promising for Black.

(*g*) Believing, probably, that the White P will soon fall, and being in fear of 12. Q to Q4. But if P × P. 12. Q to Q4, Kt to K4. 13. Kt × Kt, P × Kt. 14. Q × P, Kt to B3, Black's position is not very bad, for if White now plays 15. Q × KP (ch), Q to K2 is a sufficient answer; or if 15. Q × Kt P, Q to Q5 (ch). 16. K to R sq., Castles with a defensive game.

(*h*) A good home thrust, threatening mate.

(*i*) If Kt to Kt3, then 14. Kt to B7! or Kt × P.

BLACK.



WHITE.

(*j*) White follows up his advantage well; Black, of course, cannot take the Kt.

(*k*) Although the prospect of fixing both his Rooks on the adverse 7th file is worth something, yet it is a great error of judgment for that sake to give up the Kt, especially as by playing that Kt to B7 White wins the exchange.

(*l*) This is a mistake, which enables White to cry quits; the simple move of Kt to B3 ought to win for Black.

(*m*) This move renders Black helpless.

(*n*) Black might still have had some chance by playing P to R4, so as to enable him to give up the Kt and bring his R into play, *viâ* R3. Pawns are even.

(*o*) Giving the game away. White still had a good chance of playing for a draw if he left his K on Kt2, and would have played R to Q3. If 30. P to B7, R to B3, and the White King is not able to play past his Queen's file, so that it would have been doubtfu whether White could have won.

The following is the game played by the two favourites:—

SICILIAN DEFENCE.

White. J. Gunsberg.	Black. H. E. Bird.	White. J. Gunsberg.	Black. H. E. Bird.
1. P to K4	P to QB4	16. P to KKt4	P to K4
2. Kt to QB3	Kt to QB3	17. P × B	KP × P
3. Kt to B3	P to KKt3 (*a*)	18. Castles	Q to R5
4. P to Q4	P × P	19. Kt to K4	KR to K sq.
5. Kt × P	B to Kt2	20. Kt × P	R to K6
6. B to K3	P to Q3	21. R to Kt sq.	Kt to K4
7. Kt to Q5	Kt to B3	22. P × P	Q to B3
8. Kt to Kt5	Kt × Kt (*b*)	23. P × BP (ch)	K to R3
9. P × Kt	Kt to K4	24. Q to B2	Kt to Kt3
10. B to Q4	Castles	25. Kt to B4	R to K2
11. P to KB4	P to QR3	26. P to KR4	P to Kt4
12. Kt to B3	B to Kt5 (*c*)	27. P to R5	Kt to B sq.
13. Q to Q2	Kt to Q2 (*d*)	28. R to Q4	P × Kt
14. B × B	K × B	29. R × KBP	Q to K4
15. P to KR3	B to B4	30. R to B6 (ch)	Resigns

NOTES.

(*a*) Some of the masters do not adopt this form of the Sicilian after White has played his QKt.

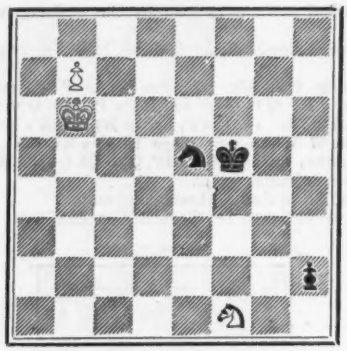
(*b*) Black should have Castled. White dare not venture upon winning the adverse Rook with 9. QKt to B7 without losing the two Knights for the Rook.

(*c*) An irretrievable blunder, which practically loses the game. 12. Kt to Kt5 should have been played.

(*d*) 13. B to R3 would not have saved the piece, because of 14. B to K3, &c.

A very instructive Ending, which occurred in a game between Donnisthorpe (White) and Mortimer (Black):—

BLACK.



WHITE.

Black to move.

It will be seen that Black's Pawn is lost. If Black plays P to R8 (Kt), then K to B7 wins; or if Kt to K7 (ch). 2. K to R7, K to Q6. 3. Kt × P, and White must win by bringing his Knight over the Queen's side and displace the Black Knight by attacking it. With careful play, it will be found that White wins in every variation.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

STUDENT.—In Problem No. 152, if 1. R to R8, K to K4. 2. R to R5 (ch), P to Q4, and there is no mate. Both the RP and KtP are necessary to effect the mate. In the Problem by E. Pradignat, if 1. R to QB4, P to K5. 2. R to B6 (ch), K to K4 (ch), and there is no mate.

M. T. HOOTON, RAVENSHOE, E. LOUDEN, W., H. A. N.—Solutions correct.

R. P. F.—You are quite right. Mr. Law's Problem 158 can be done by 1. Q to R8 (ch), &c.

Our Whist Column.

BY FIVE OF CLUBS.

A FINE PROBLEM.

THE following double dummy problem, which appeared recently in the New Orleans *Times Democrat*, is to my mind superior to the great Vienna *coup*, inasmuch as two neat points of play are involved, within the compass of six tricks:

Spades—7, 6.
Hearts—Kn, 4.
Clubs—A, 3.

Hearts—Q, 9.	B	Hearts—10, 5, 3.
Clubs—Kn, 8.	Y Z	Clubs—6.
Diamonds—Kn, 6.	A	Diamonds—Q, 7.

Hearts—A, K, 6.
Clubs—10.
Diamonds—10, 9.

Here *A* is to lead, and *A-B* are to make all the tricks. The players are supposed to see all the cards, and, of course, the six tricks are to be made against the best possible play. It is easy to make six tricks if *Y* or *Z* play ill, as, for instance, if *Y* throws away a Club, at any stage of the play; for then, of course, *A-B* have two certain tricks in Clubs, which, with the two in Hearts and the two in trumps, make the six required. But against proper play by *Y-Z*, the problem is not very easy. In fact, to unpractised players it will appear, after a few attempts, altogether hopeless; because, on every line, it seems as though *Y* and *Z* could make sure of one trick, either in Hearts, Clubs, or Diamonds, all three suits being perfectly guarded. For the guidance of such players I note that the success of *A-B* depends on their keeping open *all three* plain suits as long as possible; according to the play of *Y-Z*, *A-B* may have to make, outside the two trump tricks, three tricks in Hearts and one in Clubs, or two tricks in Hearts, one in Clubs, and one in Diamonds, or two tricks in Hearts and two in Clubs. By keeping these three possibilities open as long as possible, the problem can be solved.

It is stated that the above position occurred in actual play with four players; but that is manifestly impossible; for ten Hearts remain in the four hands, and therefore not one round of hearts can have been played, so that the position of the Hearts could not possibly have been known, as the conditions of the problem require. In actual double-dummy play, as distinguished from double-dummy problems, the position may have presented itself. If so, and *A* played correctly at a minute's notice, he must have been a capital player. For even an experienced double-dummy player need not be ashamed at being several minutes before he sees the solution of the problem. (I took more than a quarter of an hour over the problem, though I have had much practice recently over some of the fine compositions of Mr. F. H. Lewis.) The first "point" in the solution is indeed such as would occur to every Whist player at once,—but the second is not so obvious. Yet in reality the play throughout is such as true Whist principles suggest as the only sound course, and though a good player might be several minutes seeing the solution without the cards, with the cards he would probably play right throughout. The solution will be given the week after next; but solvers need not forward solutions, as every letter so sent would have to travel half over the world to reach me in my wanderings.

A querist asks the proper course to pursue with such a hand as the following, the holder having to lead:—

Spades (trumps)—A, 7, 6, 3.
Hearts—10, 7, 4.
Diamonds—9, 8, 3.
Clubs—9, 3, 2.

The first point to be attended to, in the case of so pleasing a hand as this, is to suffer no signs of exuberant joy to be expressed on the countenance. This attended to, you have to decide what to lead. The question asked me is whether you are justified in leading trumps. There is no Whist law forbidding you to lead trumps from such a hand, or even from trump 2 single, and 2, 3, 4, 5 in each of the other suits. What your partner might be justified in doing if you did lead trumps, would be a question worth considering. I can scarcely imagine any conduct too severe for a lead which distinctly implies that you hold a strong suit outside your moderately strong trumps. The proper thing to do is undoubtedly to lead the Heart 10, or the Diamond 9 (the two suits are equally weak), in the hope that fortune which has been so severe against you in giving you so bad a hand, may have given your partner a hand which will enable him at once to recognise your lead as from weakness.

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NOTICES.

Part XLIII. (May, 1885), now ready, price 1s. 3d., post-free, 1s. 6d.

Volume VI., comprising the numbers published from July to December, 1884, now ready, price 9s.

Binding Cases for all the Volumes published are to be had, price 2s. each; including parcel postage, 2s. 3d.

Subscribers' numbers bound (including title, index, and case) for 3s. each Volume; including return journey per parcels post, 3s. 9d.

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